Final
Appendix A
EPA Comment Response Summary

Berry’s Creek Study Area
Remedial Investigation

Submitted to

U.S. Environmental Protection Agency

Submitted by

Berry’s Creek Study Area Cooperating PRP Group

September 2017

550105

LIST OF ATTACHMENTS

EPA COMMENT RESPONSE SUMMARY

Appendix A presents a compilation of the Berry's Creek Study Area (BCSA) Cooperating Parties Group (the BCSA Group) responses to the U.S. Environmental Protection Agency (EPA) comments on work plans and reports prepared over the course of the remedial investigation (RI). As agreed upon with the EPA, the Phase 1 Site Characterization Report and the Phase 2 Site Characterization Report were not revised and reissued in response to EPA comments; EPA comments were considered in the development of subsequent work plans and reports. In many cases, comments received were related to topics that were the subject of ongoing or future investigations; thus, fully addressing these comments was deferred to the RI Report when all data and lines of evidence could be assembled.

The BCSA Group's comment responses are documented in the following three attachments:

- **Attachment A1** presents the subset of EPA comments on past BCSA reports that were either not fully addressed by the BCSA Group's previous comment responses, were deferred to the RI Report, or involve a topic upon which the BCSA Group's understanding has advanced as additional data, information, and analyses have become available over the course of the RI. Attachment A1 consists of a series of tables, sorted by deliverable(s), that present the EPA comment, the BCSA Group's previous response to the comment, and the location in the RI Report where the topic is discussed.[1] Where appropriate, the table includes additional detail regarding how the topic is addressed in the RI Report.

- **Attachment A2** provides a complete set of the BCSA Group's previous responses to EPA comments on the Phase 1 Site Characterization Report, the Phase 2 Site Characterization Report, the RI/FS Work Plan and Quality Assurance Project Plan (QAPP), and various work plan and QAPP addenda prepared over the course of the RI.

- **Attachment A3** provides the BCSA Group's previous responses to EPA comments on the *Memorandum on Human Exposure Scenarios and Assumptions* (MESA) and the *Pathways Analysis Report* (PAR).

[1] Note that the EPA comments and previous BCSA Group responses are replicated from the original documents; however, spelling and grammatical errors have been corrected. In addition, references to the original comment responses (Attachment A2) have been added where appropriate.

Final
Attachment A1: Summary of EPA Comments on Past RI Deliverables That Were Deferred to the RI Report

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LIST OF TABLES

Table A1. Comments on the Phase 1 Site Characterization Report Deferred to the RI Report

Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
2	General	There is an awkward avoidance of any specific company name in the reports. Even names of the Superfund sites are omitted. At the same time the NJSEA, Teterboro Airport, and landfills are specified. EPA has given deference to the BCSA Group in allowing the reports to omit the names of facilities that have contributed contaminants to the system, but the current approach seems hypocritical.	The Group has compiled available data regarding potential current and historic discharges to the BCSA (Figures 1A through 1D). The figures are provided for reference throughout the RI/FS and will be updated periodically. They identify several types of sites, using both publically-available datasets, as well as information developed during the Phase 1 investigation. Mapped locations include Group member sites as well as other facilities. The following types of sites are depicted on the figures: Superfund sites, NJDEP Known Contaminated Sites, sites with NJPDES Discharge to Surface Water permits, unpermitted outfalls observed during Phase 1, historical landfills and dumps, and historical sewage treatment plants.	RI Report - Section 6.1 presents a discussion of past and ongoing sources to the BCSA.
4	General	The agencies (EPA, NJDEP, NOAA and F&WS) have had lengthy discussions regarding the proposed reference areas. The problem seems to be that there are no appropriate reference areas in the Meadowlands for all purposes. EPA recommends selecting two different types of reference locations; specifically one for risk assessment purposes and one for risk management purposes. The risk assessment background location will be used to derive clean-up goals, while the risk management background locations will be used to fine-tune the clean-up goals to derive preliminary remedial goals which reflect the urbanization of the Site. To calculate risk assessment derived clean-up goals, EPA recommends the use of the Mullica River. The portions of the Mullica River selected should have similar salinities to the portion of Berry's Creek that it is being compared to. Sediment and surface water data should be collected from this area. Several risk management reference locations, as proposed should be continued to be investigated. These should be located within the Hackensack watershed and reflect the urbanization of the area (e.g. nutrient loading, wastewater treatment plant discharge, etc.). From these areas sediment, surface water and biota (crabs, mummichog, mammals, plants, insects) samples should be collected. EPA believes that this approach is a realistic compromise given the levels of contamination in many of the areas previously discussed as potential reference areas.	The BCSA Group recognizes that reference sites have a role to play in both the risk assessment and risk management components of the RI/FS. However, the BCSA Group does not understand the value of comparing the BCSA to a pristine reference site if remedial goals will be established in the context of an urban setting. With respect to risk assessment, cleanup goals will be derived from site-specific risk characterization and modified based on an understanding of reference site and background conditions. Further discussion of the reference sites, risk assessment, and risk management process will be included on the agenda for an upcoming meeting with EPA. With respect to the recommendation that the Group use the Mullica River as a reference location, a detailed site-specific evaluation of the Mullica River as a potential reference area for the BCSA was provided in Appendix P of the Phase 1 Site Characterization report. The evaluation used multiple criteria, consistent with relevant EPA guidance and scientific literature. Based on this analysis, the Mullica River does not meet the requirements set forth under CERCLA (i.e., that a suitable reference site exhibits the ecological conditions that would be attainable at the site but for the release of the hazardous substance [CERCLA, 43 CFR 11.14]). Unlike the Mullica River watershed, the BCSA and the Meadowlands in general have been subject to a century of non-point source pollution from urban runoff, placement of fill in the wetlands, and extensive hydrologic modifications (e.g., extensive ditching and diking to eradicate mosquitos) that are not related to CERCLA releases. In conclusion, the significant differences between BCSA and Mullica River in terms of physical, chemical, and biological characteristics make the Mullica River an unsuitable reference site for the BCSA. To further understand the influence of regional background conditions on the BCSA and the three urban reference sites, sampling of the surface water, sediment and biota was substantially increased in Phase 2. In addition, a regional background data review task has been added to the scope of work (Task 8, Section 3.8 of the Phase 2 Work Plan Addendum). These two sources of urban background and reference site data along with the extensive data from the four BCSA study segments will provide a strong basis for understanding what the site conditions would be but for the release of hazardous substances within the BCSA.	RI Report - Section 5.5 Appendix J. Section 5.5 presents a discussion of regional urban background for the BCSA site. Appendix J presents the compiled data and the results of the analyses conducted to support the evaluation of regional concentrations of COPCs in the urbanized area surrounding the BCSA.
7	General	The Conceptual Site Model does not adequately discuss the importance of resuspension due to tidal energy. More information on the non-compacted surface "fluff" layer should be incorporated into the CSM.	Resuspension mechanisms are recognized as an important component of the CSMs (Figures 3-27 to 3-31 in the Phase 1 Report, February 2010). Additional information regarding resuspension in the BCSA, including the importance of the fluff layer, was included in the Group's presentation to EPA during the work session on August 4, 2010 (slide numbers 14-17, available on the BCSA EPA Deliverables Website). The Group is proposing to take several steps to evaluate the deposition, accretion, resuspension, and erosion dynamics throughout the BCSA in more detail going forward (see Section 3.1 of the Phase 2 Work Plan Addendum; Geosyntec, April 2011). Ensuring that sufficient data are collected to thoroughly evaluate the relative importance of these mechanisms was a focus of the Phase 2 Work Plan revisions. The Phase 2 Report will present updated CSMs that reflect the Group's understanding of resuspension and sediment transport mechanisms in the BCSA based on analysis of Phase 1 and Phase 2 data.	Resuspension and the fluff layer are discussed extensively in the RI Report, including, but not limited to: Sections 4.7, 5.2, 6.2, 6.3, and 8.1.4 Appendix E - Sections 3.5 and 4.3 Appendix G - Section 3.1 Appendix H - Section 3.2.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
9	General	EPA's oversight contractor evaluated the low resolution cores using the following geochemistry criteria for radionuclide dating of sediment cores: (1) a clear Cs-137 peak with peak concentration greater than 0.5 picocuries per gram (pCi/g), (2) non-detected Cs-137 concentrations are only measured at depth intervals that are below the 1954 time horizon, and (3) same grain size exists throughout the core. The evaluation of the 27 low resolution cores that were collected in Phase 1 found only 3 cores that would be considered datable by the above criteria. The 3 datable cores include; 168 (UBC) with a 0.54 cm/yr rate; 178 (UBC) with a 0.98 cm/yr rate, and 186 (UBC mudflat) with a 0.33 cm/yr rate. Rates presented here were calculated as part of the analysis and are lower than the “preferred” sedimentation rates stated in Table O-1 in Appendix O. This information suggests that the report may overemphasize sedimentation rates with the BCSA.	It is important to recognize that the idealized conditions listed above often do not hold completely true in complex environmental settings such as the BCSA. Although radionuclide data from the Phase 1 low resolution cores do not consistently meet the requirements of an idealized profile outlined above, the Group determined that the data nevertheless provide useful information regarding deposition in the BCSA with appropriate consideration of sources of uncertainty during data interpretation. The geochronology data were therefore evaluated in conjunction with other LOEs (e.g., bathymetric, geophysical, and grain size data) when identifying appropriate locations for more detailed high resolution sediment cores in Phase 2. The Group will consider the agency comments regarding radionuclide data interpretation during the evaluation of Phase 2 high resolution cores. Please also refer to responses to Comments #231 and #234 regarding ^{137}Cs data interpretation.	Appendix F - Attachment F1 provides a comprehensive summary of the geochronological data collected during the RI, as well as the basis for estimating sediment deposition rates in each core.
10	General	A surface sediment concentration map for Be-7 bearing sampling locations only should be included. In order to evaluate recent deposition utilizing Be-7, a separate program to re-occupy the Be-7 bearing sampling locations from Phase 1 with the collection of a 0-2 cm sediment sample and analysis for Be-7, PCB (congeners?), mercury, and methylmercury should be considered. Such a program would provide better information with respect to the resuspension and transport in the system.	Results of the ^{7}Be samples proposed as part of the Phase 2 high-resolution coring program will be considered in combination with the Phase 1 ^{7}Be results, and the value of a plan-view analysis of the complete ^{7}Be dataset will be considered at the completion of Phase 2. Shallow sediment samples (0 to 2.5 cm) have been collected for COPC analysis in 40 locations as part of the Phase 2 investigation, and those results will be considered in the context of other data relating to sediment dynamics in the BCSA. Evaluation of sediment resuspension and transport are a primary focus of the Phase 2 sampling program, as described in the response to Comment #7.	Appendix F - Attachment F1 includes the results of ^{7}Be data collected during the RI.
15	General	A hydrodynamic model should be developed for Berry's Creek. Most of the data collections to support such a model are being conducted already, and the regional hydrodynamic model for the Newark Bay and surrounding waters would help provide boundary information.	The hydrodynamics of the BCSA are being evaluated in detail through collection of extensive data during a full range of flow and tide conditions over a 3 year period. The BCSA Modeling Plan calls for a careful review of the additional modeling needs following Phase 2. Modeling tools that are the best match for the BCSA physical, chemical and biological templates and site-specific study questions will be incorporated into the Phase 3 work scope. Application of the regional model, which was designed primarily for large scale TMDL analysis of major waterways, is not well suited to the finer scale transport process assessment that is required in the shallow waterway and extensive fringing marsh system of the BCSA. The BCSA Group has begun exploration of potential hydrodynamic modeling of the BCSA and is exchanging information with the UOP modeling team, which is evaluating the Ackerman’s Creek area.	A hydrodynamic model has been developed for the BCSA. The model and associated results are presented in Appendix G - Section 2 and Attachment G5.

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16	General	Further discussions are warranted between the agencies and the BCSA Group on whether dioxin should remain a COPC, and if so, how that risk calculation would be made.	As a result of recent discussions with the agencies, the Group has agreed to evaluate the dioxin-like PCB congeners from the UOP congener data and will likely collect additional PCB congener data in Phase 3. This is consistent with the findings that PCB contamination is site-related. Since dioxin is not site-related, the Group has proposed to take into account regional risk assessment of dioxins by NJDEP related to the regional fish and crab advisory. The BCSA Group will discuss this topic further with EPA.	The Group collected PCB and dioxin/furan congener data for tissue in Phase 3. These data were evaluated along with the Phase 1 dioxin/furan sediment data in the RI and Risk Assessment Reports. Appendix F - Attachment F5 Appendix L - Sections 6.1.4 and Attachment L8 Appendix M - Sections 5.6.5 and 5.6.6 and Attachment M5.
19	Executive Summary	Page ES-6, 3rd bullet from bottom – Surface water standards require comparison to unfiltered samples.	Subsequent evaluations of surface water data will consider dissolved and total concentrations, as appropriate, depending upon the constituent and exposure route being evaluated. Please also refer to the response to Comment #69 regarding selection of surface water screening criteria.	Appendix L - Attachments L4, L5, L6 Appendix M - Sections 3.4 and 5 and Attachment M1.
21	Executive Summary	Page ES-12, 3rd and 4th bullets – Please note, EPA believes it is inappropriate to utilize the camera data for adjusting consumption assumptions, although it may be discussed in the uncertainty analysis.	The camera surveys of human use will be continued at several locations. The objective is to ensure a robust data set, as well as data from additional seasons to reduce uncertainty in assumptions regarding the frequency and duration of human activity.	Appendix N presents the results of the human use surveys. These results were considered in the BHHRA (Appendix M).
22	1.2.2	Section 1.2.2, Page 1-4: The 3rd bullet under 'Ecological System' states that marsh vegetation reduces the bioavailability of contaminants of potential concern (COPCs); however, the marsh areas also provide conditions favorable to generation of methyl mercury. Given that Phase 2 is attempting to resolve some of these issues, it is premature to make such a conclusion.	The significance of marsh vegetation and sediments for COPC fate, transport, and bioavailability will continue to be evaluated during the Phase 2 RI (e.g., *Phragmites* tissue sampling, marsh sediment methylation/demethylation cores). Please refer to the response to Comment #17 in the Group's initial response to comments regarding Phase 1 Report revisions.	Section 6.3 of the RI Report presents a discussion of COPC biouptake. Chemical specific discussions of bioavailability are presented in Appendix H - Sections 2.4.7 (Hg), 2.5.5 (PCBs). Appendix L presents an analysis of ecological risk, with consideration of chemical bioavailability.
25	1.2.3	Section 1.2.3, Page 1-7: The third paragraph under 'Study Question 4' states that multiple lines of evidence indicate the Study Area is net depositional and stable. The lines of evidence should be summarized in a series of bullet items. Key empirical methods to evaluate sediment and contaminant movement are summarized in Highlight 2-10 of USEPA's Contaminated Sediment Remediation Guidance. Additional lines of evidence need to be gathered to conclude that the majority of sediments in the Study Area are stable, including time-series observations of surface sediment concentrations, comparison of concentration patterns during and after high energy events, in-situ or ex-situ erosion measurement studies (e.g., Sedflume), and further characterization of the Study Area sediment balance.	The LOEs supporting net deposition and sediment stability will be summarized in a series of bullet items in the Phase 2 Report. Regarding additional LOEs, direct measurement of sediment erosion rates via Sedflume during Phase 2 will provide a quantitative measurement of sediment stability that can be used to determine the potential for sediment mobility in the BCSA (Section 3.1.7, Phase 2 Work Plan; Geosyntec, April 2011). The findings from the sedflume study, as well as other LOEs from Phase 1 and Phase 2, will be presented in the Phase 2 Report to evaluate the role of diurnal and storm tides in sediment resuspension and transport in the BCSA. Please refer to the BCSA Group's original responses to Comment #7 for additional information regarding assessment of sediment dynamics during Phase 2, Comment #17 regarding Phase 1 Report revisions, and Comment #24 regarding evaluation of sediment transport and stability in the BCSA. Refinement of the sediment balance is a primary focus of the Phase 2 scope of work.	The net depositional and stable character of the BCSA is discussed in detail in multiple locations in the RI Report, including, but not limited to: Sections 4.7, 5.1, 6.5, 8.1.4, 8.2.3; Appendix F - Section 3 Appendix G - Section 3.
29	1	Page 1-22, second paragraph: Please add RAGS F (2009) to the list of EPA guidance documents.	RAGS F (2009) will be listed as a reference in future documents regarding the BHHRA. Please refer to the BCSA Group's original response to Comment #17 (Attachment A2) regarding Phase 1 Report revisions.	Please refer to Appendix M - Section 1.2.

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30	Figures 1-4	Figures 1-4 a, b, c: The deep 15-30 cm transect cores are not depicted in the figures. A figure should be provided that includes the results of deeper sediment core slices.	The series of Figures 1–4a through d used a global legend that depicted all symbols used in the series, but deep transect cores were only collected in UBC (Figure 1–4d) during Phase 1. The legend will be corrected on the relevant Phase 2 Report figures.	Please refer to Appendix F - Attachment F3.
33	2.1.1	Section 2.1.1, Page 2-3: Summarize the water budget analysis for Lower Berry's Creek. This segment was omitted in this section of the report.	The referenced section was intended to provide a brief summary of the key findings of the water budget analysis and to emphasize updates from the preliminary water budget analysis presented with the Phase 1 Work Plan. Important considerations from the water budget analysis for LBC are summarized below. Due to its direct connection with the Lower Hackensack River and limited upland runoff inputs, LBC is more efficiently flushed by tidal action than the upper reaches of the BCSA. Historically, LBC supported substantially greater tidal energy; however, construction of BCC and the resulting reduced connection of LBC with the rest of the BCSA waterways resulted in a substantive reduction in the tidal prism conveyed through LBC. The degree of connectivity between LBC and BCC and MBC was not fully understood at the time the Phase 1 Report was submitted. Additional hydrologic data was collected subsequent to submission of the Phase 1 Report, and data collection will continue throughout Phase 2. The water budget for LBC will be revisited in the Phase 2 Report.	Detailed discussions of the BCSA water budget are provided in Appendix G - Section 2 and Attachment G2.
35	2.1.2.4	Section 2.1.2.4, Page 2-7: A brief description of bathymetric data by reach should be included in the text.	A brief description of the bathymetric data will be included in the Phase 2 Report and RI Report. A detailed description of site-wide bathymetric data for the main stem of Berry's Creek was presented in Appendix IV (Bathymetric Final Report) of the "Geophysical Investigation of Surface and Subsurface of Berry's Creek and Berry's Creek Canal Study Area (BCSA)", submitted to EPA in June 2008, and is available on the EPA Deliverables Website.	Appendix G - Section 3.2 presents a detailed discussion of the BCSA morphology drawing from multiple data sets, including the bathymetry data sets. Attachment G1 presents the digital elevation model that was developed for the BCSA site.
38	2.1.3.1	Section 2.1.3.1, Page 2-11: Although turbidity levels may increase in reaches closer to the Hackensack River during spring tides, the PRPs should also state that turbidity levels are generally lower closer to the Hackensack River and higher in the upper reaches (UBC) as observed in summary table provided in text.	Based on a review of the data presented in the referenced summary table, the average high tide turbidity was similar in BCC and UBC; average low tide turbidity was slightly higher in UBC. The minimum turbidity measured during the three quarters available at the time the Phase 1 Report was submitted was measured in UBC (5.1 NTU), and the maximum turbidity was measured in BCC (183.4 NTU). Patterns in water quality parameters will be further evaluated at the conclusion of Phase 2. Please refer to the Group's original response to Comment #17 (Attachment A2) regarding Phase 1 Report revisions.	Appendix E - Section 3.5 presents a discussion of spatial and temporal distribution of suspended solids in BCSA based on multiple LOEs (including turbidity).
40	2.1.3.1	Section 2.1.3.1, pp. 2-12, dissolved oxygen - Based on the data shown on the table on 2-13, it does not seem appropriate to say that the highest DO levels are observed during low tide.	Based on a review of the indicated text, the statement is accurate as presented. The text states that the DO concentrations were typically highest during low tide; the only exceptions to this statement are the minimum and average values recorded at stations BCC and PPR. Patterns in water quality parameters will be further evaluated at the conclusion of Phase 2.	Appendix E - Section 3.2 presents a discussion of DO levels in BCSA.
41	2.1.3.1	Section 2.1.3.1, Page 2-13: For seasonally-variable parameters, such as Dissolved Oxygen, it would be better to organize the data table presentation by season and then by minimum, maximum, and average.	Comment noted. The Group will evaluate alternative means of presenting the water quality data during the Phase 2 data analysis.	Seasonal patterns in BCSA water quality are presented in Appendix E - Sections 3.2 and 3.5.2.
42	2.1.3.1	Section 2.1.3.1, pp. 2-13, dissolved oxygen – The table included lots of values that show levels of supersaturation of oxygen. Please confirm that these values are correct, as the system seems to have numerous occurrences with this condition. If there is supersaturation during the day, because of algal blooms, then what happens at night time? Often the respiration at night can deplete dissolved oxygen to levels insufficient to support fish populations. Further evaluation of this is warranted.	The DO concentrations presented on page 2-13 are correct. All monitoring stations exhibited periods of both oxygen supersaturation and hypoxia, consistent with scientific literature regarding estuarine water quality. DO saturation is known to vary widely in estuarine systems on diurnal, seasonal, and interannual timescales (e.g., Wenner et al. 2004). Instances of oxygen supersaturation are often attributable to photosynthetic activity, though supersaturated conditions do not necessarily imply the existence of algal blooms. The solubility of oxygen at 25˚C and zero salinity is approximately 8.2 ppm O_2, and solubility decreases as temperature and/or salinity increase (USGS 2006). Fluctuations in DO concentrations with respect to season, time of day, and tide stage are therefore to be expected. DO concentrations were not evaluated with respect to time of day as part of the Phase 1 analysis. Patterns in water quality data, including DO, will be further evaluated at the conclusion of Phase 2.	Appendix E - Section 3.2 presents a discussion of DO levels in BCSA.

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44	2.1.3.2	Section 2.1.3.2, p. 2-19, bottom of third paragraph – Starting at "prepatory…." These sentences are confusing. State which party implemented the action.	Sediment removal in the vicinity of the West Riser Tide Gate was conducted by Morton International, consistent with the EPA-approved Sediment Removal Action Work Plan. The sediment removal was conducted to fulfill the requirements of an Administrative Order on Consent (AOC) between Morton and EPA. Future descriptions of this work will note that is was completed by Morton.	A full description of the sediment removal action in the vicinity of the West Riser Tide Gate is provided in Parsons (2010).[b]
46	2	p. 2-21: Over four months, the report notes there was very little net freshwater from the creek into the Hackensack River. This may be an artifact of the analysis given that the number is obtained by subtracting a very large quantity from a similarly large quantity, and neither is known to the 1 m^3 degree of accuracy.	The uncertainty in the freshwater flow estimate is acknowledged in the second paragraph of page 2-21. The cause of this uncertainty (i.e., the fact that the tidal influx to and tidal efflux from the BCSA are large and nearly equal) clearly demonstrates that the freshwater flow is small relative to the tidal flows (i.e., if freshwater flows were large, the difference between the tidal efflux and influx would be greater and the calculation less uncertain). Consistent with many hydrodynamic aspects of an estuarine system such as the BCSA, quantifying freshwater flows is complex and requires multiple LOEs to reduce uncertainty. Uncertainty in this calculation will be reduced as additional data are collected for the system and the calculations are tested against other LOEs. The calculations presented in the Phase 1 Report are consistent with the current understanding of freshwater inputs to the system based on the water budget and on the observed salinity gradient across the BCSA. Substantial additional measurements of freshwater inputs will be collected during Phase 2 (refer to Section 3.1.6 of the revised Phase 2 Work Plan), and the water budget will be discussed further in the Phase 2 Report.	Appendix G - Attachment G2 presents a detailed analysis of the BCSA water budget based on multiple LOEs. Appendix D presents an analysis of upland baseflow and storm runoff to the BCSA.
48	2.1.4.1	Section 2.1.4.1, Page 2-23, Third Paragraph: Preliminary sediment flux calculations should be completed using available TSS data.	The available TSS dataset was limited to three quarters of monitoring at the time the Phase 1 Report was submitted, and the correlation to turbidity, for which there was a more robust dataset, was relatively weak (see Phase 1 Report, Figure 2-16). The Group therefore determined that attempting to calculate a sediment balance using the data available at the time would not provide meaningful information. Additional TSS measurements will be collected in Phase 2 (refer to the BCSA Group's original response to General Comment #3 [Attachment A2]), and sediment flux calculations will be reevaluated based on the complete Phase 1 and Phase 2 dataset.	Appendix G - Section 3 and Attachment G3 present a detailed discussion of the sediment flux analysis, including the basis for the suspended solids concentrations used in the calculations.
49	2.1.4.3	Section 2.1.4.3, Page 2-24, Last bullet: In this bullet (and also in Appendix O and other relevant sections of the report that discuss sediment core geochronology), the text should be modified to identify some of the potential limitations of the evaluation of sediment core Cs-137 data. Due to the potential for sediment transport due to storm events and anthropogenic activities, the deepest detection of Cs-137 in a particular core may not represent the 1954 horizon (although the sediments are certainly from 1954 <u>or</u> a more recent date) and the peak detection of Cs-137 in a core may not represent 1963 because the 'true' peak sediment may have been eroded or removed at some point. Discontinuous core profiles can confound attempts to estimate deposition rates and additional criteria for evaluation of profiles are required, for example, at least a 0.5 pCi/g detection of Cs-137 to confirm the presence of the 1963 sediment horizon.	Comment noted; please refer to the BCSA Group's original response to Comment #17 [Attachment A2] regarding Phase 1 Report revisions. Potential limitations of Cs-137 data will be taken into account during analysis of the combined Phase 1 and Phase 2 geochronology dataset, and noted in the Phase 2 Report.	Appendix F - Attachment F1 provides a comprehensive summary of the geochronological data collected during the RI, as well as the basis for estimating sediment deposition rates in each core.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
50	2.1.4.3	Section 2.1.4.3, Page 2-25, First bullet: In this bullet (and also in Appendix O and other relevant sections of the report that discuss sediment core geochronology), the text should be modified to identify some of the potential limitations of the evaluation of sediment core lead-210 (Pb-210) data. Changes in the Berry's Creek watershed over history, including the construction of the Oradell Reservoir and increasing upland development, have likely contributed to changes in Pb-210 deposition and are likely to confound attempts to calculate deposition rates that assume constant deposition. Downcore Pb-210 profiles may be of extremely limited utility in this system.	Comment noted; please refer to the BCSA Group's original response to Comment #17 (Attachment A2) regarding Phase 1 Report revisions. Potential limitations of Pb-210 data will be taken into account during analysis of the combined Phase 1 and Phase 2 geochronology dataset, and noted in the Phase 2 Report. Historical changes to the BCSA watershed and Hackensack Meadowlands that may have influenced sediment deposition will be evaluated as part of the Phase 2 investigation (Task 8 – Regional Background Data Review). The potential effect of these changes on interpretation of geochronology data and calculation of sediment deposition rates will be taken into account during the Phase 2 data analysis.	Appendix F - Attachment F1 provides a comprehensive summary of the geochronological data collected during the RI, as well as the basis for estimating sediment deposition rates in each core.
51	2.1.4.3	Section 2.1.4.3, Page 2-25, First Bullet and Page 2-27, Third Bullet: The report states that the Be-7 "data were evaluated in a qualitative fashion to identify areas with deposition in the past several months; any positive readings were found to be indicative of recent deposition" (page 2-25). A surface sediment concentration map for Be-7 bearing sampling locations only should be included. In order to evaluate recent deposition utilizing Be-7, a separate program to re-occupy the Be-7 bearing sampling locations from Phase 1 with the collection of a 0-2 cm sediment sample and analysis for Be-7, PCB (congeners?), mercury, and methylmercury should be considered. This would provide better information with respect to the resuspension and transport in the system.	Please refer to the response to Comment #10.	Appendix F - Attachment F1 includes the results of ^{7}Be data collected during the RI.
52	2.1.4.3	Section 2.1.4.3, Page 2-25, Second Bullet: The placement on pre-1950 material (non-detected Cs-137) on top of post-1950 material (Cs-137 bearing) indicates a physical discontinuity in the core and the assumption of constant deposition does not hold. Consequently, cores are not datable (including cores 134, 137, 138, 139, 140, 167, and 183). Calculation with the "cesium horizon method" needs additional justification.	Potential sources of uncertainty associated with interpretation of geochronology results will be evaluated in detail and discussed further in the Phase 2 Report. Nondetect results for ^{137}Cs do not automatically indicate that the associated sediment was deposited before 1954. Theoretical and observed profiles of ^{137}Cs, such as in Zapata (2002), show that deposited ^{137}Cs activities decrease steadily in more recent time. Hence, we would predict that shallow samples, assuming they represent recent sediment, would have relatively low ^{137}Cs. Additionally, the presence of sand, to which radionuclides do not strongly sorb, may contribute to nondetect results for ^{137}Cs in some samples. Despite this, it is possible, as noted in several core interpretations presented in Appendix O of the Phase 1 Report, that discrete intervals of pre-1954 sediments may have been deposited in relatively shallow horizons overlying post-1954 sediment as indicated by ^{137}Cs presence. These intervals may be due to the erosion of old (pre-1954) soils in upland or marsh areas due to unusually high-energy storm events or changes in upland development patterns. While it is therefore possible that some discontinuity may exist in some of the cores (e.g., the majority of the core results from gradual deposition of recent waterborne sediment, whereas discrete intervals of atypically-aged sediment are added through episodic, high-energy storm events), such behavior does not automatically render the entire core of no value for quantitative interpretation. If most of the core presents a coherent trend for interpretation, it is reasonable to proceed with deposition rate estimation accepting that the interruption of the core by limited, episodic events of discontinuous deposition may introduce limited error to the arithmetic in the analysis.	Appendix F - Attachment F1 provides a comprehensive summary of the geochronological data collected during the RI, as well as the basis for estimating sediment deposition rates in each core.

Table A1. Comments on the Phase 1 Site Characterization Report Deferred to the RI Report

Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
53	2.1.4.3	Section 2.1.4.3, Page 2-25, Second Bullet: The identification of potential 1954 and 1963 horizons from Cs-137 data should be confirmed, to the extent possible, by evaluation of downcore COPC profiles based on contaminant production/release history.	Downcore COPC profiles were evaluated in conjunction with the geochronology data in Appendix O of the Phase 1 Report. Geochronology data (including Phase 2 high resolution cores) will continue to be evaluated with respect to COPC profiles in Phase 2.	Appendix F - Attachment F1 provides a comprehensive summary of the geochronological data collected during the RI, including the distribution of COPCs with depth.
54	2.1.4.3	Section 2.1.4.3, Page 2-27: Summarize geomorphological settings for the cores that are identified as depositional locations.	The Group will conduct an analysis of depositional patterns with respect to geomorphological setting as part of the Phase 2 analysis.	Appendix F - Attachment F1 provides a comprehensive summary of the geochronological data collected during the RI, including the geomorphological setting of each core.
55	2	p. 2-28 second to last bullet: The last sentence is confusing because of the verb tense of “reaching”. Is the statement that BCC was built with excess capacity so it is hasn't yet reached equilibrium (i.e. it is currently in the process of reaching equilibrium or it has reached and maintained equilibrium)?	The sentence intended to state that the geochronology data from Phase 1 indicate that deposition is still occurring in BCC, and that equilibrium has not been reached. However, this analysis will be re-evaluated as part of Phase 2.	Please refer to Appendix F - Section 3.2.1 and Appendix G - Section 3.2.3.
56	2.2	p. 2-29, Section 2.2, General Comment: In general, the text only considers precipitation events as the cause for the observed contaminant distribution; however, the data do not show a clear correlation. Other contributors should be considered as well such as tidal influence, turbidity, and resuspension.	The Group recognizes that precipitation events are not the only factor contributing to the observed distribution of COPCs in BCSA surface water. Tidal influence (flow velocity direction) was taken into account in both the discussion (page 2-33, first bullet; page 2-34, second bullet) and the data presentation on Figures 2-20a-h (flow direction and magnitude indicated by arrows inset in symbols). However, tidal influence appeared to have a relatively small effect on COPC distribution based on the three quarters of monitoring data evaluated. The difference in COPC detection frequency between wet and dry monitoring events appeared to be more apparent than the difference between flood and ebb tide, particularly for mercury and PCBs. The influence of suspended particulates on COPC fate and transport was also evaluated through a comparison of paired filtered and unfiltered sample results (pages 2-35 and 2-36, and Figures 2-22a-d). The factors influencing COPC distribution, transport, and fate will continue to be evaluated during Phase 2, and the findings will be updated in consideration of the combined Phase 1/Phase 2 dataset. The importance of resuspension in the BCSA is a focus of the Phase 2 scope of work, as discussed in the response to Comment #7 and presented in the revised Phase 2 Work Plan (Geosyntec, April 2011).	The RI Report - Section 5.2, Appendix E - Section 4, and Attachment E1 present detailed discussions of the factors that influence the spatial and temporal distributions of COPCs in surface water.
59	2.2.2.1	Section 2.2.2.1, Page 2-32: The Phase 1 Report states, “An important consideration in the evaluation of the data is precipitation events during the sampling event, as described in Section 2.2.1 above.” Important considerations should also include time of year and point in tidal cycle when sample was taken.	Please refer to the BCSA Group's original responses to Comments #41 and #56 (Attachment A2). The factors potentially influencing COPC concentrations in surface water (seasonality, tidal influence, suspended sediment, etc.) will be evaluated in consideration of the combined Phase 1 and Phase 2 dataset.	These factors are discussed in RI Report - Section 5.2, Appendix E - Section 4, and Attachment E1.
63	2.2.2.1	Section 2.2.2.1, Page 2-33: More discussion should be included regarding the conclusion that ebb and flood tide water column mercury concentrations are similar (automated quarterly samples), with respect to boundary conditions and other factors.	More detailed analysis of ebb vs. flood tide surface water COPC concentrations will be included in the Phase 2 Report. Please refer to the BCSA Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2).	Please refer to Appendix E - Section 4.3; Attachment E1, Sections 3.1 and 3.2; and Exhibit 1 Figures 81 to 102.
66	2.2.2.1	Section 2.2.2.1, Page 2-34, First Bullet: The information provided in this bullet (regarding an equipment malfunction in the laboratory) should be mentioned as a caveat in the previous bullet while discussing the results.	This comment will be taken into consideration during the preparation of the Phase 2 Report. Please refer to the BCSA Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2).	Please refer to Appendix K.

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69	2	Page 2-35, last paragraph, last sentence: "Evaluation of filtered data in comparison or in addition to unfiltered data serves multiple purposes. It allows a refinement of the CSM of COPC fractionation between particulate and dissolved/fine particulate phases and the attendant implications for COPC transport. It also supports an evaluation of exposure point concentrations that is more relevant than unfiltered concentrations for ecological and human health receptors. It is for this reason that surface water ARARs are best compared to filtered surface water data as opposed to unfiltered data." Surface water ARARs are best compared with unfiltered samples for an RME scenario as human receptors are likely to contact the whole water. Filtered results may underestimate EPCs. It may be useful to screen both unfiltered and filtered data sets.	Subsequent evaluations of surface water data will consider dissolved and total concentrations, if appropriate. The aquatic life NJSWQS for metals, for example, are explicitly expressed as a dissolved criteria, and therefore, comparisons to total concentrations are not consistent with the intent of the criteria. The saline waters human health NJSWQS were developed to protect humans from consumption of fish (not water), and therefore, comparison to dissolved chemical concentrations (which best represents the bioavailable fraction for uptake) was deemed appropriate. Future risk evaluations will utilize total or dissolved concentrations depending upon the exposure route being evaluated.	Risk analyses related to this comment are discussed in Appendix L - Attachments L4, L5, L6 and Appendix M - Sections 3.4 and 5 and Attachment M1.
71	2	Page 2-36, second bullet: Reporting filtered PCB detections as "rare" may downplay the importance of PCBs in the water column. The number of detections in filtered water was greater than 5% of the total and several samples exceeded the ARAR.	Appropriate terminology to describe infrequent detections will be considered during the preparation of the Phase 2 Report. Please refer to the Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2).	Appendix E - Section 4.1 presents a discussion of filtered and unfiltered COPC data, including PCBs.
76	2.3.3	Section 2.3.3, Page 2-42, Second Bullet, Section 2.3.3.6, Page 2-53; and Figure 2-43: EPA agrees that it is likely that one main source of polychlorodibenzodioxins/furans (PCDD/F) to Berry's Creek is tidal interactions with Newark Bay. However, the information selected may overstate this assessment. For example, Footnote 1 in Figure 2-43 indicates that it includes sediment data from <u>all depths</u> in Newark Bay. (No footnote was provided to explain the data source for the Lower Passaic River and the associated wide error bar.) However, no mechanism has been proposed to explain how sediment buried in Newark Bay might impact Berry's Creek. This analysis should have been conducted including only 2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCDD) concentrations in surface sediments or on suspended solids, since these are the solids most likely to be transported with the tides and impact Berry's Creek.	The objective of the analysis in Section 2.3.3.6 was to evaluate the potential for BCSA-specific sources and to facilitate comparative analysis between study segments, as well as to evaluate regional conditions that may have led to the presence of dioxins in the study area. Within the study area, a decreasing concentration gradient is evident with distance from the Hackensack River, supporting the absence of BCSA-specific sources. The regional analysis utilized readily available data from other studies. The footnote identifying the data source for the Lower Passaic River was inadvertently left off of Figure 2-43, and the complete citation (Ehrlich 1994) is included in the References section of this document. These data are for surface sediments (0–5 cm) in the Lower Passaic River, and the error bar reflects the reported range of concentrations. Data originally presented for Newark Bay were derived from the summary statistics (Tables 4-13 and 5-13) presented in the Phase 1 and Phase 2 Sediment Investigation Field and Data Report (Tierra 2008) for all data. Tierra (2008) presented surface sediment summary statistics for 2,3,7,8-TCDD only (Tables 4-27 and 5-25), which would not have been sufficient to compare PCDD/F fingerprints as shown in Figure 2-47. Although the average surface sediment TCDD concentration is lower than the average for all sediment depths, the conclusions presented in Section 2.3.3.6 of the Phase 1 Report do not change. More detailed evaluation of regional COPC concentrations is proposed in Phase 2 (Task 8 – Regional Background Data Analysis), and potential regional contributions to BCSA sediment COPC concentrations will be evaluated further in the Phase 2 Report. Figure 2-43 will be revised to reflect surface sediment concentrations if additional analysis of dioxin/furan concentrations is undertaken in future deliverables.	Appendix F - Attachment F5 presents the results for PCDD/F analyses in BCSA sediment.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
82	2.3.3.5	p. 2-52, Section 2.3.3.5, Pesticides: The report notes, “Only three pesticides, aldrin, beta BHC, and heptachlor epoxide, were observed in concentrations that exceeded the observed levels in the Reference Sites.” Screening out of contaminants based on concentrations in areas potentially affected by the site rather than by the potential effect of the contaminant itself is not appropriate. For example, chlordane concentrations in BCSA sediment exceed sediment benchmarks but are not evaluated. While pesticides are not predicted to play a significant role in management decisions for the site, risk assessment guidance recommends that they should still be carried through human health and ecological risk assessments since some detections were above screening levels.	Site-related chemicals that are detected frequently and above regional background concentrations and screening-level risk benchmarks will be considered in the baseline risk assessments, though as noted in EPA’s comment above, most of these compounds are not predicted to be important in the risk management decisions for the site. Use of reference sites to identify site-related conditions is consistent with CERCLA, Superfund risk assessment, and sediment management guidance, and the Group maintains that consideration of regional background conditions is necessary to support the development of realistic and achievable sediment management strategies for the site. The Group has previously provided information to EPA that supports the use of the selected reference sites to represent regional background conditions that are unaffected by the site. Additional analysis of regional background concentrations of COPCs is proposed as part of the Phase 2 scope of work (Task 8 – Regional Background Data Analysis), and the results will be considered in the evaluation of site-specific COPCs. The Group can provide additional information in the Phase 2 or RI/FS Report, as requested, to evaluate the potential that chemicals from the site were transported to the selected reference sites.	RI Report - Section 7 - pesticides selected as COPCs and addressed throughout risk assessments Appendix E - Attachment E3 Appendix F - Attachment F5 Appendix L - pesticides selected as COPCs and addressed throughout BERA Appendix M - pesticides selected as COPCs and addressed throughout BHHRA.
85	2.3.4	Section 2.3.4, p.2-54, Non-COPC Stressors: The report notes, “In other cores, BOD levels decrease with depth, which may indicate the ultimate consumption of BOD over time” or could it represent areas where erosion has occurred? Also the presence of industrial chemicals can impact BOD and should be noted here.	The Group reevaluated the cores that demonstrated decreasing BOD concentrations with depth (TBZ-116, TBZ-141, TBZ-142, TBZ-149, TBZ-159, TBZ-167, TBZ-169, and TBZ-185). Of these eight cores, five showed evidence of net deposition since 1954 so erosion is unlikely to explain the observed trend at these locations. Insufficient data are available to determine whether the observed decrease in BOD with depth may be attributed to consumption of BOD, erosion, or other factors. A subset of the Phase 2 sediment samples will be analyzed for BOD. The combined Phase 1 and Phase 2 BOD results will be evaluated in the context of geochronology and COPC data, and discussed in the Phase 2 Report.	Appendix F - Section 4.3 presents a discussion of these data and the role of sediment labile organic carbon on redox conditions. Attachment F1 presents a detailed analysis of sediment cores and sediment deposition rates.
89	2	Page 2-64, fifth paragraph: Please indicate that white perch were found in large numbers in UBC during spawning in the spring as was discussed during the presentation.	Factors contributing to fish abundance and distribution (including spawning) will be further discussed in the Phase 2 Report. Please refer to the BCSA Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2).	Appendix L - Section 2.4.4 describes the BCSA fish community
97	2	Page 2-78, third bullet: Non-detect values should be incorporated into the dataset using the ROS method (ProUCL version 4.00.04: http://www.epa.gov/esd/tsc/software.htm). A comparison to ½ the detection limit method should be discussed in the uncertainty section.	The referenced discussion on page 2-78 is related to statistical comparisons of the Phase 1 data and is not an explicit discussion related to potential exposure concentration estimation approaches (e.g., UCL). At this time the utility and appropriateness of the regression order statistics (ROS) approach is uncertain, but may be considered along with other methods (including simple substitution methods), based on the combined Phase 1 and 2 data sets. With respect to ProUCL guidance on ROS methods, Singh et al. (2006) indicated that “even though several of the substitution and ROS methods have been incorporated in ProUCL (for historical reasons and comparison purposes), those methods are not recommended by ProUCL to estimate the EPC terms or to compute other decision statistics.” The utility of ROS is unresolved for environmental datasets with more than mild variance and skewness (e.g., see Singh et al. 2006; Shumway et al. 2002; Gilliom and Helsel 1986). As additional data are added through the Phase 2 effort, use of proxy values for nondetected results will be assessed on a case-by-case basis and depending upon the intended use of the data (e.g., statistical comparisons versus exposure concentration estimations).	Appendix K - Attachment K2 summarizes the data handling and treatment protocols used in data summations presented in the RI.

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107	3.1	Section 3.1, Second Paragraph, Page 3-1: Revise the third sentence since Spartina is the natural cordgrass in the Meadowlands and is the preferred habitat for aquatic and semi-aquatic species	A detailed evaluation of landscape changes is proposed as part of the Phase 2 scope of work (see Phase 2 Work Plan, Task 8 – Regional Background Data Review), and will include an analysis of historic vegetation changes in the BCSA. However, based on a preliminary review of available documents and previous analyses conducted by the Group, Spartina does not appear to have been a historically dominant species in the BCSA. As presented in the Aerial Photograph Analysis Technical Memorandum (ELM, July 2008; available on the EPA Deliverables Website), the dominant vegetation species in the BCSA was historically Atlantic white cedar, a freshwater species (see drainage map, 1896, Figure 2 included in the BCSA Group's original comments response [Attachment A2]). Atlantic white cedar continued as the dominant species over a large portion of the BCSA until the 1920's when construction of the Oradell Dam and surface water diversion decreased freshwater flow in the Hackensack River, resulting in the conversion of freshwater swamp into brackish marsh, and dieback of the cedars. The preferred salinity range for Spartina alterniflora is approximately 10–20 ppt (Landin 1991), higher than the average salinities observed in the BCSA during Phase 1 even near the confluence with the Hackensack River (7.61 and 9.03 ppt in BCC and LBC, respectively). It is therefore unlikely that Spartina would have been widespread in the BCSA during the transition from cedar swamp to *Phragmites* marsh. Furthermore, review of historic aerial photography for the BCSA indicates that the study area had entirely transitioned to a *Phragmites* marsh by 1930 (see attached aerial photograph, 1930, Figure 3 included in the BCSA Group's original comments response [Attachment A2]). Analysis of historic landscape changes in the BCSA will continue going forward and will be discussed further in the Phase 2 Report. If the agencies can provide references related to the historic dominance of Spartina in the BCSA, those reference will be evaluated as part of the Phase 2 analysis.	Refer to Appendix I - Attachment I7 which presents the results of a vascular flora survey in BCSA.
109	3.1	Section 3.1, pg. 3.2, 1st Bullet – It should be mentioned here that a significant amount of contaminated sediment was removed during the installation of the new rail line across the UOP site.	The Phase 2 Report will include discussion of the sediment removal during rail line construction, as well as the additional sediment removal planned at the UOP Site. Please refer to the BCSA Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2).	Please refer to the site timeline presented in Appendix B.
111	3.2	Page 3-3, Section 3.2: Please add a discussion describing how new information on hydrodynamics has changed the previous water budget (add specifics to each bullet, if possible).	BCSA hydrology and hydrodynamics are a primary focus of Phase 2 data collection, and will be discussed in detail in the Phase 2 Report. Please refer to the BCSA Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2).	The final water budget incorporating all available LOEs collected during the RI is detailed in RI Report - Section 4.7.2; Appendix G - Section 2; and Attachment G2.
112	3.2.1	Section 3.2.1, Page 3-4, Bullet "Tidal Prism": The Ph1 Report states that UBC is characterized by the least tidal energy and shallow water depth, and that it is predicted to support the greatest sediment deposition rates. However, Phase 1 data as presented by the PRP contradict this conclusion. For example, Figure 2-19 presents sedimentation rates as currently calculated in the report. As it can be seen in this figure, sedimentation rates in the upper reaches of the creek are lower than those of the lower reaches of the creek. (Please also refer to comments on Appendix O.)	The referenced statement was intended to emphasize that the conditions (lower energy, shallow water) favor sediment deposition in UBC relative to other areas of the BCSA. However, the statement erroneously indicates that sedimentation rates are thus higher in UBC than in other areas of the BCSA. Sedimentation rates are affected by several independent factors including sediment supply. TheLOEs being collected during Phase 2 will help to better quantify the spatial variation of sedimentation rates in the system and factors affecting them (e.g., energy, sediment supply, morphology).	Sediment transport and deposition are described in Appendix G - Section 3 and RI Report - Section 4.7.3.
113	3.2.1	Section 3.2.1, Page 3-5, Top Paragraph: Clarify the phase "multiple tidal cycles," since the average tidal residence time of 20 hours would imply that Upper Berry's Creek would be flushed out every two tidal cycles, or once a day.	The preliminary tidal residence time calculations suggest that under average tidal conditions, approximately 2 tidal cycles are required to fully exchange water in the BCSA; while under neap tide conditions approximately 4 tidal cycles are required. These estimates will be updated in Phase 2.	Please refer to RI Report - 4.7.2 and Graphic 7; and Appendix G - Section 2.

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114	3.2.1	Section 3.2.1, Page 3-5, Bullet “Flushing/Mixing”: The Ph1 Report does not adequately discuss tidal resuspension. EPA agrees that “tidal action is the dominant mechanism by which water is transported through the system” (page 3-5). It is also the dominant mechanism impacting sediment resuspension and exchange with the marshes. Impacts on tidal flushing and sediment resuspension need to be included.	Please refer to the response to Comment #7 regarding resuspension. Tidal flushing will continue to be evaluated as part of the Phase 2 Hydrology and Hydrodynamics sampling program. Exchange with the marshes is being evaluated as part of the Phase 2 scope of work (refer to Section 3.2.2.1 Marsh-Waterway COPC/Suspended Sediment Exchange of the revised Phase 2 Work Plan). The water budget will be discussed in further detail in the Phase 2 Report.	Tidally-driven resuspension of fluff layer materials is discussed throughout the RI Report, including, but not limited to: Sections 4.7, 5.2, 6.2, and 8.1.4; Appendix E - Sections 3.5, 4.3, and 5; Appendix G - Sections 2.5.3 and 3.1; and Appendix H - Section 3.2.
116	3.2.2	Section 3.2.2, Page 3-7, third paragraph: Other options for characterizing sediment load transported from the risers and other tributaries, such as sediment trap sampling, should be explored. The core profiles in Appendix O do show some signs of sandy or other coarse grained sediment layers.	Please refer to the BCSA Group's original response to Comment #37 regarding characterizing upland sediment inputs and the use of sediment traps (Attachment A2). The stratigraphy and composition of the existing and proposed cores will be examined during the Phase 2 data analysis to provide additional LOEs on sediment sources and transport patterns.	Evaluation of sediment loads to the BCSA is presented in multiple locations in the RI Report, including: Appendix D - Section 5; Appendix F - Section 3.2; Appendix G - Section 3; and Attachment G3.
117	3.2.2	Section 3.2.2, Page 3-8, Bullet “Tidal Flux”: Turbidity measurements have shown poor correlation with TSS measurements thus far, so it is inappropriate to present conclusions on solids transport which are based on turbidity measurements.	The Group recognizes that the relationship between turbidity and TSS is complex, and significant additional direct measurements of TSS have been added to Phase 2 to better characterize the relationship between these parameters, as discussed in the Group's original response to Comment #3 (Attachment A2). The results presented in the Phase 1 Report were based on only two quarters of data, and as stated in the report, should be considered preliminary. Although the correlations were poor in the preliminary analysis, the comparison of the turbidity measurements through the system among sensors regularly calibrated to the same turbidity standards are valid comparisons. Detailed evaluation of sediment flux in the BCSA will be presented in the Phase 2 Report and will incorporate data from both Phase 1 and Phase 2. The sediment flux analysis will rely on multiple LOEs (e.g., LISST, OBS, acoustic backscatter data, geochronology, geomorphology, etc.) in addition to the relationship between turbidity and TSS measurements. Preliminary evaluation of some Phase 2 data indicates a much improved relation (August 4, 2010 presentation to EPA).	Appendix G - Attachment G3 presents an analysis of the BCSA sediment flux, including the basis for quantifying suspended solids concentrations. Acoustic backscatter data were found to provide a good relationship to TSS.
120	3	p. 3-11: Sediment load from uplands runoff is estimated at 59 million kg, apparently based on the NURP values from p. 3-7 taking the current urban runoff value and multiplying it over 39 years. However, the conditions in the past were not necessarily the same as today, particularly the NJSEA which is excluded from the load calculations on p. 3-7 because it now drains to a settling pond. Might it have been a more significant load in the past? Same with CSOs: hopefully there are some BMPs now that were not in place in 1963? If runoff loads were greater in the past, then that would leave a smaller load to be assigned to tidal input from downstream. It also might mean lower present sedimentation rates. In general, caution must be used when extrapolating across significantly different time periods, and the uncertainties raised by that extrapolation should be discussed.	The Group concurs that sediment loading from uplands runoff changed over time in response to changes in the BCSA watershed. Historical changes to the BCSA watershed and Hackensack Meadowlands that may have influenced sediment supply, transport, and deposition, including construction of the NJSEA facility, will be further evaluated as part of the Phase 2 investigation (Task 8 – Regional Background Data Review). These factors will be considered in future analyses of the BCSA sediment dynamics.	Sediment loads to the BCSA and the potential influence of historic modifications to the watershed are discussed in RI Report - Section 4.1; Appendix B; Appendix D - Section 5; Appendix F - Attachment F1; and Appendix G - Section 3.

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121	3	The report notes "This analysis is consistent with the CSM… which indicates that the Hackensack River is the primary source of sediments to the system." Rather than discussing whether two conceptual models are consistent with one another, whether they are consistent with empirical evidence should be discussed. This analysis indicates that the Hackensack is the source of about 50% of the sediment in Berry's Creek, but is that number changing with time? Going forward, the Phase 2 Work Plan described here will address some of these concerns, but #3 should include not only the contemporary sediment balance but the historical movement of sediment. The historic release of contamination from the BCSA to the Hackensack River should be evaluated to help understand current contaminant transport.	The Group concurs that additional empirical evidence is required to evaluate the CSM for sediment transport in the BCSA, and will continue to evaluate factors influencing sediment flux going forward. Collection of data required to characterize sediment sources and sinks in the BCSA is a primary focus of the Phase 2 investigation, and the Phase 2 Report will present a detailed analysis incorporating both Phase 1 and Phase 2 data. Factors influencing historic sediment transport in the BCSA will be considered with respect to interpretation of sediment core data (i.e., geochronology and COPCs), and to the extent they are relevant, to current and future sediment and COPC transport. In addition, a chronology of factors that have changed the hydrology and sedimentology of the BCSA is being prepared as part of the Phase 2 work.	Please refer to RI Report - Section 4.1 and Appendix B for discussions of historical factors that have influenced sedimentation in the BCSA. Appendix G - Section 3 and Attachment G3 present the detailed analysis of sediment transport and mass flux in the BCSA.
122	3.3.4.2	Section 3.3.4.2, pg. 3-20 – The FDA standards and other human health criteria for fish consumption should be included in the discussion of fish tissue results in this section and throughout the report.	This section of the Phase 1 Report was intended to summarize concentration patterns of key site COPCs, and not to provide information relative to the risks posed by these same compounds; therefore, risk-based concentration standards were not presented. Future discussion of the risk significance of measured residue levels will utilize site-specific standards. Because FDA action levels are applicable to chemical concentrations in products within the commercial market, they are not directly applicable to an evaluation of chemical concentration data for site fish and crab.	Appendix M presents the BHHRA.
124	3.4.3	p. 3-24, Section 3.4.3, Hackensack River: The Hackensack River receives discharges from the BCSA and fish collected in that region have elevated Hg concentrations. Hg concentrations in deeper sediments near the Hackensack River increase with depth similar to the pattern observed near the source of the Hg. Discussion of the Hackensack River data being compiled into regional "background" data set should acknowledge that the contamination in the Hackensack River could be directly related to releases from within BCSA.	The Phase 2 scope includes an evaluation of regional background sediment concentrations, including data from the Hackensack River. The distribution of mercury concentrations will be evaluated in relation to potential sources, which are distributed along the Hackensack River estuary. These data will be thoroughly discussed in the Phase 2 Report.	Regional background is discussed in RI Report - Section 5.5 and Appendix J.
127	3.5.1	Section 3.5.1, Page 3-26: The report states, "Mercury concentrations in sediment have generally attenuated in all horizons across the recent decades, as have surface water concentrations. These findings indicate the primary sources of mercury have been controlled or substantially reduced." This type of statement seems to try to diminish the potential risk from the site, and does not acknowledge that there are still significantly elevated levels of mercury in surface sediment.	The Group acknowledges that COPC concentrations in surface sediments exceed screening criteria at many locations throughout the BCSA (see Section 2.3.3 and Appendix G of the Phase 1 Report), and the referenced text does not suggest otherwise. Analysis of potential human and ecological risk is ongoing, and will be discussed in more detail in the BERA and the BHHRA.	BERA and BHHRA are presented in Appendix L and Appendix M.

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128	3.5.1	Section 3.5.1, Page 3-26, First bullet: Is it correct to state that mercury concentrations have attenuated in all horizons, including the deeper sediment horizons corresponding to the periods of largest contaminant release? The statements regarding attenuation of contaminants in Berry's Creek do not have sufficient context in terms of likely current deposition rates and projected recovery timeframes to useful for site decision making. These conclusions, which appear throughout the report, should be qualified in each instance to reflect the associated uncertainties in the data set and interpretations. According to USEPA's Contaminated Sediment Remediation Guidance, lines of evidence to support natural recovery should also include demonstrated trends of decreases in biota contaminant levels, water column concentrations, and BAZ sediment concentrations.	The BCSA Group agrees that the RI data will need to be evaluated with regard to the LOEs to support natural recovery. Discussion of COPC patterns and apparent attenuation trends in the Phase 2 Report will be done with more specificity and clarity.	RI Report - Section 6.5; Appendix F - Section 3.4; and Attachment F1 present a comprehensive evaluation of natural recovery in BCSA.
135	3	Page 3-30, last paragraph: "Screening benchmarks were not available for some chemicals. In these cases, if a benchmark was available for a chemical that was considered a reasonable surrogate (e.g., based on similarities in chemical structure), the benchmark for the surrogate was used for the chemical to support the COPC screening effort." Currently, EPA does not have an approved method for selection of surrogates. If a contaminant is suspected to be driving risk and no screening benchmarks are available to quantitatively evaluate the risk, please retain the contaminant and add language in the risk characterization and uncertainty sections discussing the degree to which risk is likely underestimated, if possible.	None of the compounds without published screening criteria are expected to be driving risk at the site. Nevertheless, the final baseline risk assessments will note which compounds do not have screening or toxicity criteria and discuss the implications in the risk characterization and uncertainty sections. The Phase 2 sampling includes a subset of samples to be analyzed for all TAL/TCL analytes, regardless of the availability of benchmarks.	Please refer to Appendix L - Attachment L8; Appendix M - Table 5-7; and Attachment M1.
136	3	Page 3-31, first paragraph: "A few analytes have no published benchmarks and no reasonable surrogate. With the exception of methyl mercury, chemicals without screening benchmarks are not evaluated further." If there is no benchmark, the compound should be retained and a statement should be included in the risk characterization and uncertainty sections to explain that the risks may be underestimated because there was no toxicity value for compound(s) x (y, z, etc.). Depending on the concentration of the contaminants, a degree of uncertainty may be estimated.	Compounds without benchmarks will be discussed in the risk characterization and uncertainty sections of the baseline risk reports. The Phase 2 sampling includes a subset of samples to be analyzed for all TAL/TCL analytes, regardless of the availability of benchmarks.	Please refer to Appendix L - Attachment L8; Appendix M - Section 3.2 and Table 5-7; and Attachment M1.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
138	3	Page 3-31, third paragraph: "…the maximum detected concentration of each chemical was compared against media-specific screening benchmarks on a BCSA-reach-specific basis. For surface water, dissolved metal concentrations were used." Please explain how the media-specific benchmarks were derived. To remain conservative, total metal concentrations should be used.	Media-specific benchmarks were derived from published sources. New Jersey-specific values were used if available. The text provides the discussion of the source of values and the derivation of values for chemicals with no benchmarks. The Group agrees that the most conservative approach is to compare surface water benchmarks to total measured concentrations. As noted in the response to Comment #69, subsequent evaluations of surface water data will consider dissolved and total concentrations, as appropriate. The aquatic life NJSWQS for metals, for example, are explicitly expressed as dissolved criteria, and therefore, comparisons to total concentrations are not consistent with the intent of the criteria. The saline waters human health NJSWQS were developed to protect humans from consumption of fish (not water), and therefore, comparison to dissolved chemical concentrations (which best represents the bioavailable fraction for uptake) was deemed appropriate. Future risk evaluations will utilize either dissolved or total concentrations depending upon the exposure scenario being evaluated.	Please refer to Appendix L - Section 3.3.4; Attachments L2, L5; and Appendix M - Attachment M1.
140	3	Page 3-32, second paragraph: "In applying USEPA's contaminated sediment management principles to COPC selection for the BCSA, only chemicals that were frequently detected (>5 percent) and at concentrations that were above risk-based benchmarks were considered. Chemicals that met each of these criteria in each of the three samples media were selected as primary COPCs for the BCSA. Chemicals that met these criteria in two media were considered for inclusion as secondary COPCs." It does not appear to serve a purpose to categorize COPCs as primary or secondary in this manner, but rather on concentrations and frequency of detection.	Both primary and secondary COPCs are detected frequently and at elevated concentrations relative to risk-based standards. The Group recognizes that the terms "primary" and "secondary" are a nuanced characterization that describes the prevalence of these compounds across media, and may not be critically important in defining site conditions. In any event, both primary and secondary COPCs are included in the Phase 2 analyses.	The RI continues to use primary and secondary COPC terminology. The secondary COPCs are thoroughly addressed in the Risk Assessments (Appendices L and M); and an analysis of the secondary COPCs is presented in Attachments E5 and F5.
141	3	p. 3-32: The report states, "In applying USEPA's contaminated sediment management principles to COPC selection for the BCSA, only chemicals that were frequently detected (>5 percent) and at concentrations that were above risk-based benchmarks were considered. Chemicals that met these criteria in each of the three sampled media were selected as primary COPCs for the BCSA. Chemicals that met these criteria in two media were considered for inclusion as secondary COPCs." Given the high screening criteria and the fact that some chemicals will partition mainly to one media, chemicals that met criteria in only one media should also be retained as COPCs. Pesticides should also be retained as COPCs, they are widespread in many places so should not be eliminated based on that fact. Their origin may be uncertain however, they may contribute to risk in this area and need to be retained to help with risk interpretation.	The primary purpose of the COPC screening presented in the Draft Report was to provide some rationale to focus 1) the data discussions presented in the Phase 1 Report on a subset of detected chemicals and also 2) the subsequent sampling to be conducted in Phase 2 on key, risk-driving chemicals. The Group is confident that the approach used has identified the key risk driving chemicals that ultimately will be the focus of sediment management strategy developed for the site. Nevertheless, the Phase 2 investigation includes a subset of samples to be analyzed for all TAL/TCL compounds (including pesticides; see the BCSA Group's original response to General Comment #3 on the Phase 2 Work Plan [July 27, 2010 letter to Doug Tomchuk; Attachment A2]) and these additional compounds will be considered in the baseline risk assessments to be conducted for the site.	Please refer to Appendix M and Appendix L.
		The fourth paragraph notes that, "…a number of metals…were also present in surface water above benchmarks and background." It is unclear what is meant by background or why data are being screened against "reference" or "background" this early in the risk assessment process (also as shown in Table 3-7).	The term background, as used in the Phase 1 Report, refers to the reference sites that were selected to represent the conditions at the BCSA except for the BCSA-specific release of CERCLA substances. Previous communications with EPA have provided the rationale and overall support for the selection of these sites as representative reference sites for the BCSA, which will be augmented in Phase 2 with a regional background evaluation.	Please refer to Appendix M and Appendix L.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
144	3	p. 3-40: The report notes the BAZ was estimated to be 6 cm in depth in UBC and 10 cm in depth in the other reaches. It would be useful to re-visit the work the SPI work that was previously conducted to ensure that the methodology used to establish these depths is still appropriate prior to any additional sampling. See additional comments on Appendix C below.	The BCSA Group will continue to conduct an integrated analysis of the different types of sediment data, including the SPI work, as more data are collected as part of Phase 2.	Appendix F presents an integrated analysis of sediment at the BCSA site, including the SPI work.
145	3.7.4	Page 3-40, Section 3.7.4: Please update this section to include exposure scenarios and assumptions that have been updated by EPA in the recent comment document.	This section of the Phase 1 Report did reflect agreed upon changes to the human exposure pathways. Subsequent risk assessment deliverables will also reflect those agreements.	Please refer to RI Report Sections 2.4, 2.5, 6.3 and 6.4; and Appendix M.
151	Figures 3-5 and 3-6	Figures 3-5 and 3-6: It is difficult to see the depurated and whole body results, respectively. Perhaps choose a different color.	Comment noted; please refer to the Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2). Clarity of figures will be evaluated during preparation of the Phase 2 Report.	The RI did not include a discussion of depurated vs non-depurated COPC residues in mummichog so these changes were not needed.
170	Appendix F	Appendix G, General Comments: A section describing the presence of endangered or threatened species in the Study Area should be added to the SLERA.	Please refer to the BCSA Group's original response to Comment #17 regarding revisions to the Phase 1 Report (Attachment A2). The potential presence of threatened or endangered species in the BCSA will be discussed in the BERA.	Please refer to Appendix L - Section 2.4.7.
174	Appendix G	Appendix G, Section 2.1.2, Page 2-5: It should be noted that constituents without benchmarks will be carried into the Baseline Ecological Risk Assessment (BERA) where they will be addressed in the uncertainty analysis.	Constituents without benchmarks will be addressed in the uncertainty section of the BERA.	Appendix L - Attachment L8 presents the BERA uncertainty analysis.
175	Appendix G	Section 2.2.1, Page2-6: The selection process for determining the contaminants of potential ecological concern (COPECs) included the use of frequency of detection and comparison to reference areas. These methods are not appropriate for a screening level ecological risk assessment (SLERA) which is inherently conservative. Additionally, the sediment benchmarks used for screening of COEPCs in the SLERA (Section 2.1.2, SLERA Benchmarks, p. 2-4) involved, in most cases, using the upper end of the NJDEP screening benchmarks (e.g., ERMs). The Phase 1 report states, "... the low effect values such as the ERLs were not considered relevant for COPC selection screening in an urbanized and industrialized waterway in which the cumulative impacts of historical urbanization and development (outside of CERCLA releases) has led to a decreased in sediment quality." However, the ERLs are appropriately conservative for the SLERA and should be used instead of the ERMs.	With respect to the overall intent of this comment, the primary purpose of the SLERA was to support a decision regarding the Scientific/Management Decision Point (SMDP) as to whether chemicals at the site pose an ecological risk and whether additional study is warranted. The secondary purpose was to identify the chemicals, receptors, and pathways to be the focus of the subsequent BERA. The Group is confident that the approach used has appropriately identified the need for a BERA and the appropriate focus of that BERA. Though more conservative screening approaches might generate a larger chemical list, the relevance of these chemicals for supporting risk management decisions at the site is low. With respect to the specific comments regarding the use of background data to identify COPECs, the approach used in the SLERA was designed to identify the site-related chemicals that potentially contribute to ecological risk in the BCSA and that might warrant further study. Because the entire Meadowlands region surrounding the site has a high background burden of chemicals in the surface water, sediment, and fish, background concentrations must be considered if the subsequent BERA investigation is going to be designed to address site-specific risks. EPA's ERAGS guidance allows a refinement of the COPC list during the refined problem formulation, but before the design of field studies. Because the problem formulation for the BERA has been on-going since the RI/FS scoping activities and Work Plan development where it was initially discussed, the refinement of COPCs to consider background was considered appropriate in the SLERA. Nevertheless, the Phase 2 field investigation includes a subset of samples for analysis of all TAL/TCL compounds. The results of this sampling will be evaluated in the BERA and the potential risk significance of any site-related chemicals will be assessed. With respect to EPA's comment regarding the use of ERMs, please refer to the BCSA Group's original response to Comment #131 (Attachment A2).	Appendix L - Attachment L2 presents the COPEC screening results.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
176	Appendix G	Appendix G, Section 2.2.2, Page 2-7: The use of arithmetic average constituent concentrations in sediment, surface water, and tissues as exposure estimates are inappropriate in a screening level assessment. Section 1.1 of the SLERA states that conservative assumptions regarding exposure and toxicity were used, which is consistent with guidance. However, use of arithmetic average exposure estimates is neither conservative nor consistent with guidance. The reasonable maximum exposure point concentration must be used to estimate exposure in the SLERA.	Maximum detected concentrations were compared to benchmarks in the SLERA. The results of these comparisons are presented in Table G5. Arithmetic average concentrations were used in a further evaluation of risks to assess the patterns of risk across BCSA study reaches and by chemical. The comparison of mean concentrations to benchmarks was conducted to refine our preliminary understanding of potential risks at the site and to identify the key chemicals contributing to ecological risk. The COPCs identified via this assessment will be the focus of subsequent data collection and the BERA. However, the final BERA Report will include an evaluation of the risk posed by all detected site-related chemicals, and the Phase 2 investigation includes a subset of samples for the full TCL/TAL compound list.	The BERA is presented in Appendix L, including a detailed description of all risk calculations.
177	Appendix G	Appendix G, Section 2.2.2, Page 2-7: Text in the second paragraph of this section states that filtered surface water data was used to calculate Hazardous Quotients (HQs). Although use of filtered results is suitable for metals whose benchmarks are expressed on a dissolved basis, they are not suitable for organic constituents. Unfiltered surface water results for organics provided in Attachment 1 should be used to calculate HQs.	Risk evaluations in the BERA will consider unfiltered results, as appropriate.	Please refer to Appendix L - Attachments 5 and 6.
178	Appendix G	Appendix G, Section 2.2.3: The use of surrogates should be mentioned in the uncertainty analysis, as there are no criteria for certain COPECs in certain media, and so using surrogates introduces some uncertainty to the SLERA.	The use of chemical surrogates will be discussed in the uncertainty section of the BERA Report.	Appendix L - Attachment L8 presents the uncertainty analysis for the BERA.
181	Appendix G	NOAA sediment criteria should specify whether they are marine or freshwater criteria in this table and all tables. Also, NOAA surface water criteria are not “saline”, but rather “marine” and should be corrected in all tables.	Please refer to the BCSA Group's original response to Comment #17 (Attachment A2) regarding revisions to the Phase 1 Report. All tables in the Phase 2 Report will correctly identify sediment and surface water criteria as either marine or freshwater, where warranted.	The SLERA and BERA used ecological screening criteria published by NJDEP as part of the evaluation of sediment chemical data. The terms *freshwater* and *saline* are used as listed in the NJDEP criteria table. NJDEP. 2009. Ecological screening criteria. Available at: www.nj.gov/dep/srp/guidance/ecoscreening/. New Jersey Department of Environmental Protection, Trenton, NJ. March 10
182	Appendix G	Appendix G, Table G1: COPECs for which a surrogate value is presented should be noted in this table, as the cited source of these values below the table are the NJDEP or NOAA values, when in fact they are surrogates and represent the criteria for a different COPEC, and may not even be the same type of criteria type as the selected surrogate. For example, 1,2,3-Trichlorobenzene lists an LEL but the surrogate is an ER-M for 1,2-Dichlorobenzene. An asterisk should be used to indicate COPECs with surrogate criteria in Table G1.	It is correct that the surrogate screening value for 1,2,3’-TCB was incorrectly listed as an LEL when it should be identified as an ER-M. This correction will carry through to the BERA Report. We reviewed the remaining surrogates listed, and they are appropriately listed with the correct benchmark type. Table G-2 identified all the chemicals for which surrogates are used. Any future deliverables will note in appropriate tables any instance where a surrogate value is used.	Please refer to Appendix L - Attachment L2.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
183	Appendix G	Appendix G, Table G1: COPEC-specific criteria should be used whenever they are available. Sediment criteria for alpha and beta BHC should be used rather than the surrogates, as these COPECs have freshwater LELs. A surrogate was also used for indeno(1,2,3-cd)pyrene, though this COPEC has a NJDEP LEL which is lower than the selected surrogate (0.26 versus 0.2).	We chose to use the more conservative sediment screening benchmark for the gamma isomer to represent all BHC isomers due to structural similarity. It is correct that the most recent NJDEP sediment standards update shows a screening benchmark for indeno(1,2,3-cd)pyrene. This was an updated value since we prepared the draft report. This change in the screening value (0.26 versus 0.2) will not affect the risk results. The current version of screening criteria will be considered at the time the BERA Report is prepared.	Isomer-specific screening benchmarks were used for HCHs, as available. The BERA addressed total PAHs in sediment rather than individual PAHs. Appendix L - Attachment L2.
184	Appendix G	Appendix G, Table G1: As noted for sediment above, Table G1 should note which values are surrogate values because as presented, the table presents specific criteria in cases where none exist for a COPEC. In all subsequent tables, any COPEC criteria which don’t actually exist (all COPECs where a surrogate criterion is used) should be noted in the table.	Any future deliverables will note in appropriate tables any instance where a surrogate value is used.	Please refer to Appendix L - Attachment L2.
189	Appendix G	Appendix G, Table G5: A footnote to this table states that mummichog tissue data from reference areas was used to screen Study Area data for white perch and blue crab because this was the only species sampled in reference areas. Although lipid-normalization of organic constituent tissue data helps to address some inter-species differences, lifestyle differences between species may also have a large effect on bioaccumulation. Therefore, sampling of white perch and blue crab from reference areas should be included in Phase 2 and comparisons of Study Area to reference areas performed as part of the BERA to confirm COPECs for these species.	The Phase 2 sampling program includes sampling of both white perch and blue crab from reference sites for COPCs. A detailed comparison of tissue concentrations between the BCSA and reference areas will be included in the Phase 2 Report and the BERA.	Please refer to Appendix L - Attachment L2.
191	Appendix G	Appendix G, Attachment 1 (Table G1a): The detection limit for a number of COPECs exceeds the criterion, but for those COPECs where there was a non-detect, the Maximum Detected Exceeds Benchmark column says “no”. For example, for PCB-1242, the criterion is 3.00E+01, and the average sediment concentration using half of the detection limit for non-detects is 3.53E+01, yet the maximum is presented as a non-exceedance. However, if the average (half of the detection limit) exceeds the criteria, then it cannot be said that the maximum does not exceed the criteria. This should be corrected by replacing “ND” in the max column with less than the detection limit (>#.##E-##) and the exceedance presented as “ND” or unknown, rather than assuming that an unknown maximum value is below the criteria.	These requested changes will be incorporated into future deliverables.	The requested changes are captured in Appendix L - Attachment L8.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
193	Appendix H	Appendix H, Section 3.1, Page 3-1, Second Paragraph: The text indicates that a box model was used. Include details of the calibration of the box model, including the rational for using 18 boxes. Provide details of any sensitivity analysis conducted. How did assumptions at model boundaries (boundary conditions) affect the box model results? What bathymetry and bottom roughness were assumed?	The box model described in the referenced section is the conceptual basis of the water budget analysis and is described in Appendix A of the RI/FS Work Plan (Geosyntec 2009), including rationale for the segmentation of the system into boxes based on upland drainages and waterway features. Although such a model is not calibrated in the manner done for numerical computer models, the water budget box model was shown to be consistent with the conditions (e.g., salinity trends, water quality parameter responses to storm events, calculated tidal and freshwater fluxes) observed in the BCSA during the initial phases of Phase 1. Additional validation of the water budget box model will be completed during Phase 2 based on the larger monitoring data set (e.g., dye testing studies, upland runoff analysis). Sensitivity analyses were performed by testing the box model over a range of plausible values for the model inputs (e.g., tidal amplitude, precipitation magnitude, evapotranspiration rate). The model boundary conditions are defined by the inlets of the BCSA at the lower Hackensack River and the upland drainage boundary. The latter was defined by EPA and sensitivity of the model predictions to this area definition was not directly considered in the box model. The conditions at the BCSA inlets at the Hackensack River are well defined by the tidal amplitude data collected at moored stations MHS-01 and MHS-02. The bathymetry data collected during the scoping activities work (as augmented in Phase 1) were used to define the tidal prism for a range of tidal amplitudes. Bottom roughness is not relevant to water budget calculations.	The box model has been replaced by numerical hydrodynamic and sediment transport models, which are discussed in detail in Appendix G and Attachments G5 and G10.
195	Appendix H	Appendix H, Section 3.1, Page 3-4, Bullet "Flushing and Circulation": Provide more detailed information or methodology describing how the data set will be used to calculate the exchange between segments and exchange with the lower Hackensack River.	Salinity in the BCSA is derived from exchange with the river and thus temporal and spatial changes to the salinity gradient provide for an understanding of freshwater inputs, flushing, and circulation within the BCSA and exchange with the Hackensack River. The data collected from the moored stations constitute a long-term monitoring record of the BCSA hydrodynamics over a range of site conditions, such as tides, storm events, and outfall discharges. Trends in salinity (and other water quality parameter data) from the stations will be evaluated against other data sources (e.g., tidal elevations, precipitation amounts and predicted runoff quantities, wind speed/direction, dye test studies, timing and rate of discharge from the NJSEA outfall) to assess the response of the system, as a whole and between segments, to changes in system conditions. Analyses will be completed to quantify the observed water quality parameter response to specific perturbations of system conditions (e.g., large rainfall events, high winds, etc.) and to provide insight to the key processes affecting exchange within the system and with the lower Hackensack River. Analytical calculations, such as calculation of dispersion rates and flushing times as described by Thomann and Mueller (1987) and Fisher et al. (1979), will be used to quantify system behavior over a range of observed site conditions.	Appendix G - Section 2 presents a detailed analysis of the BCSA hydrodynamics based on multiple LOEs developed over the course of the RI.
196	Appendix H	Appendix H, Section 3.1, Page 3-4, Bullet "Relationship of TSS and NTU": Discuss the feasibility of a turbidity-TSS relationship approach to support the goals of this section, i.e., organic and inorganic sediment flux. In particular, describe how the variability and uncertainty in the relationship will be handled in flux calculations. Will ADCP backscatter also be used as a TSS surrogate? What is the backup plan if a successful calibration between Turbidity and TSS is not observed?	As discussed during the August 4, 2010 work session with EPA and other stakeholders, quantification of the relationship of TSS to turbidity is complex and requires an approach based on multiple LOEs. Quantification of the relationship between suspended solids measurements and continuously monitored water quality parameters, such as turbidity, at the moored stations is a primary focus of the Phase 2 program (refer to the BCSA Group's original response to Comment #3 [Attachment A2]). The program includes extensive TSS sample collection over a wide range of conditions, as well as characterization of other parameters likely to influence TSS concentrations/characteristics (e.g., chlorophyll-a, particle size distribution, and dissolved, particulate, and total organic carbon analyses). In addition, as discussed during the August work session, the relationship of ADCP backscatter data to TSS has been shown to be an effective surrogate for turbidity for estimating suspended solids in the BCSA. Collectively, the extensive data set developed through Phases 1 and 2 will provide for a robust understanding of the relationship of suspended sediment to the long-term, continuous data (turbidity, ADCP backscatter) collected at the moored stations. Uncertainty in this relationship will be considered in future calculations of sediment fluxes.	Appendix G - Section 3 and Attachment G3 present a detailed discussion of the sediment flux analysis, including the basis for the suspended solids concentrations used in the calculations.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
197	Appendix H	Appendix H, Section 3.1, Page 3-5, Bullet "Sediment Balance": The Modeling Plan assumes that field measurements of sediment loading from upland, quantification of sediment exchange between segments, and estimate of autochthonous production will provide the deposition rate in sediment balance calculation. This assumption is based on the accurate measurement and estimation of each term. Provide more detailed justification of sediment balance calculation in terms of uncertainty of the estimation relative to the sediment deposition rate.	Two of the LOEs to answer the questions of sediment deposition rates and sediment balance are the geochronology data (Phase 1 and 2) and estimation of the current sources of sediment (e.g., upland runoff, autochthonous production/deposition, sediment transport from Hackensack River), measured directly in the BCSA to the extent practicable. These LOEs and other relevant factors (e.g., Sedflume results) will be evaluated concurrently to answer the related study questions and consider the uncertainty factors.	Appendix G - Section 3 and Attachment G3 present a detailed discussion of the sediment flux/balance analyses; and relates these findings to other LOEs collected during the RI.
198	Appendix H	Appendix H, Section 3.2, Page 3-7, Bullet "Establish Relationship Between Particulates and COPC Movement": Section 3.2 needs to be further developed and should consider the following concerns: How will be variability in water column concentrations affect the COPC filter size fractionation study? Would a sediment transport calculation be conducted for each of the particle size fraction filtered from the water sample?	The Phase 1 LISST data and the Phase 2 LISST data to date show a bimodal distribution in particulate size fraction, with one group of "fine" particulates (on the order of 10 µm size) and a second group of "coarse" particulates (on the order of 100 µm size). Because the observed system velocities are insufficient to maintain 100 µm particles composed of inorganic material (i.e., sand) in suspension, the coarse size particulates are organic in nature. As described in Section 3.2.2.3 of the Phase 2 Work Plan Addendum, the particulate COPC fractionation task will involve quantification of the distribution of COPC concentrations between fine (mud, silt, clay) and coarse (sand size) particles through filtration methods. Samples will be collected at mid-flood and high-slack tide during two sampling events: one in warm weather and one in cold weather. These data will provide an understanding of the distribution of COPCs between the two primary particulate fractions in the BCSA and how this condition varies in response to organic productivity levels (high during warm weather, low during cold weather) and tidal phase. The results of this study will be used to assess the potential significance of suspended particulate size on COPC transport. Based on this analysis, a determination will be made whether further quantitative analyses are necessary to support risk analysis and remedy evaluations.	Appendix E - Sections 4 and 5 and Appendix H Section 3 present an analysis of COPC concentrations and transport in surface water. This analysis considers multiple LOEs, including particulate concentration and composition.
213	Appendix N	The BERA work plan includes an assumption that surface water risks are negligible. What about suspended sediment exposures, effect of high detection limits, seasonal or weather driven changes in chemical concentration and possible changes in bioavailability?	Surface water risks will continue to be evaluated in light of the complete Phase 1 and Phase 2 dataset. Factors influencing risk associated with surface water exposures, such as those listed above, will be evaluated in the BERA.	Exposure to COPCs in suspended particulates is considered in the BERA Appendix L. The RI Report includes evaluates the role of particulate resuspension of surface water quality in multiple locations, most notably Appendix E - Section 4.
214	Appendix N	The organisms being used as receptors in the risk assessment are pollution tolerant. While this is an urban waterbody, the goal should be to improve the water quality to allow native species to inhabit the area. Receptor species should be chosen based on their likelihood of susceptibility as well as their importance in a restored ecosystem. Certain species may be rare in the recent surveys. Perhaps they would return if the system was remediated. This issue also applies to Phragmites. It may not be appropriate to base a decision on allowing continued production of this invasive species.	The BERA includes a wide range of assessment and measurement end points that are representative of the range of pollution tolerances found in the Hackensack River estuary. Goals for improved water quality can be realistically set for the BCSA using these species, consistent with State and regional (e.g., NJMC) goals for the Hackensack River estuary. With regard to *Phragmites* , its dominance in the Meadowlands pre-dates industrial discharges and was caused primarily by hydrology and salinity changes resulting from other human activities. In addition, although invasive, its relative capacity to maintain highly productive tidal marshes in an urban ecosystem stressed by relative sea level rise will be a necessary part of the risk analysis.	Please refer to Appendix L - Section 3.1.2.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
216	Appendix N	p. 3-10: The BERA work plan notes, "Sediment toxicity of COPCs is likely limited or overall risks are less than risks to aquatic predators." Sediment toxicity testing should be conducted. Also, was pore water analyzed for metal concentrations? Since AVS is high, confirmation that pore-water concentrations are below AWQC would support limited bioavailability of metals.	The need for sediment toxicity testing and pore water analysis is being discussed with EPA based on the evaluation of the Phase 2 benthic community data and other sediment data and risk assessment needs.	These topics are discussed in RI Report - Section 4.2 and Appendix L - Attachment L9.
217	Appendix N	p. 3-12, Section 3.3.1, Measures of Exposure: The BERA work plan states, "COPC residues that exceed those detected in reference site biota will be used to assess site-specific exposure and risk." Literature values should be used to assess exposure and risk.	Literature values will be used along with site-specific data to assess site-specific risks.	Appendix L - Literature and site-specific data are used throughout the BERA to evaluate risks. All chemicals detected above screening-level benchmarks were selected as COPCs and were evaluated in the risk assessment.
218	Appendix N	Section 3.1, Page 3-2: It is noted that based on acid volatile sulfide and simultaneously extracted metal (AVS/SEM) SEM metals in sediment are not bioavailable or likely to contribute to sediment toxicity. Under field conditions, the certainty of this method's predictive ability is relatively unproven and has significant limitations to its applications. For example, this method is not very useful in the more oxic conditions of the sediment which is where most of the biological activity exists. Additionally, use of the AVS/SEM approach requires that the sediments are never disturbed or changed from the parameters examined to make the ratio calculations. Therefore, the information used from this analysis should not be considered significant in the weight of evidence evaluation.	These factors will be considered appropriately in the final WOE evaluation presented in the BERA.	The role of AVS on metals bioavailability is discussed in Appendix F - Section 4, Appendix H - Section 2, Appendix L - Section 6, and Attachment L9. The AVS data are considered in the context of other LOEs to support the overall CSM for the site.
220	Appendix N	Section 3.2.1, Page 3-5: The Assessment Endpoints included in the BERA do not include the benthic macroinvertebrate community. It may be appropriate to consider protection and maintenance of the benthic macroinvertebrates an assessment endpoint since they are an important part of the community and the food chain.	As discussed during the February 2 and 3, 2010 meeting, the Group has evaluated the many factors that will likely influence COPC effects on benthic organisms in the BCSA. Based on this evaluation, the Group has recognized that prior to the Phase 2 work little was known about the benthic community in the BCSA waterways. The New Jersey Meadowlands Environmental Research Institute (MERI) collected a small number of samples in BCC as part of a larger study of the Meadowlands (Bragin et al. 2009), and a limited study was completed in Oritani Marsh, which included a few samples in BCC (Barrett and McBrien 2007). In addition, limited benthic invertebrate community characterization was completed in the Eight Day Swamp area (Weis and Weis 2003). No studies using consistent methods and sub-habitat stratification were conducted prior to the Phase 2 BCSA work. In addition, studies had not been completed in LBC or MBC, where there is a significant range of salinity and other parameters that influence benthic community composition. Consequently, the Group has implemented the benthic community survey across the BCSA study segments and the most representative reference area with regard to salinity and substrate composition (Bellman's Creek), to understand community composition and variability. The Group will evaluate the potential utility of the benthic community as a measurement endpoint based on the results of the Phase 2 work.	Please refer to RI Report - Section 4.2; Appendix L - Sections 5.3 and 6.1.5; and Attachment L9.

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Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
222	Appendix N	Section 3.3.1, Page 3-12: It is noted that tissue levels in reference site biota will be used to assess site-specific exposure and risk. However, literature values should be used to assess exposure and risk.	Literature values will be used along with site-specific data to assess site-specific risks.	Appendix L - Literature and site-specific data are used throughout BERA to evaluate risks. All chemicals detected above screening-level benchmarks were selected as COPCs and were evaluated in the risk assessment.
223	Appendix N	Section 3.3.1.1, Page 3-12: The measurement endpoint for the fish community involves surface water and sediment contaminant concentrations. Additionally, it may be appropriate to consider the comparison of fish tissue contaminant residue data with critical body residue effects concentrations/toxicity reference values as another measurement endpoint for the fish community.	Residue-effect data will be considered in the risk assessment (along with data from other LOEs) if reliable and defensible critical body residue effect levels are available. Many of the published critical body residues available to date have significant data quality limitations and are of questionable reliability and applicability to the conditions in the BCSA. The BERA Report will discuss available residue-effect levels and identify those reliable for use in the baseline assessment.	Please refer to Appendix L - Section 5.2 and 6.1.4; and Attachments L5 and L7.
231	Appendix O	The application of a “cesium horizon method” is questionable. If an appropriate Cs-137 peak cannot be identified, then the core has likely been disturbed, and the determination of the pre-1950 layer would not be appropriate as the assumption of constant deposition does not hold.	Response: There are multiple reasons why a ^{137}Cs peak may not be identifiable in a 1 m core that do not result from core disturbance. These include the following: • The 10 cm interval used in Phase 1, could lead to a dilution of the sediment with peak activity with surrounding sediment of lesser activity. As a result, two or more consecutive samples may have elevated yet similar results with no clear peak identified. • Changing sorptive characteristics of the sediment (e.g., an abrupt change in grain size distribution or organic carbon presence) could lead to spurious variations in radionuclide activity, which could confound analyses. For example, the loading of organic matter from sewage outfalls changed substantially repeatedly in quality and relative location between 1950 and present. • Continuous, relatively rapid deposition may have occurred in the top 1 m at a particular core location, such that it represents post-1963 sediments; in such a case, the ^{137}Cs peak would be present deeper than 1 m. As noted elsewhere in these responses, the Group will review the Phase 1 core data along with the Phase 2 data to support a consistent interpretation of the chronology data	Appendix F - Attachment F1 presents a detailed analysis of the geochronological data collected during the RI investigation.
233	Appendix O	Appendix O “Overall Interpretation of Lower Berry Creek” First Paragraph: The report states that the center channel is “near a state of siltation equilibrium.” However, the two cores used as examples (108 and 115) more likely illustrate a net-erosional locations.	Please refer to the response to BCSA Group's Original Comment #8 (Attachment A2) regarding characterization of depositional environment. TBZ-108 is interpreted as being slowly depositional (likely close to equilibrium) based on several LOEs, including ^{137}Cs and ^{210}Pb signatures that indicate rates of deposition that are in reasonable agreement (in light of measurement error) as well as detected ^{7}Be. TBZ-115, in a thalweg pool, is interpreted as no net change. Based on the ancillary LOEs discussed in the response to Comment #8, there is no evidence to suggest that these areas are net erosional. Comments regarding interpretation of geochronology data will be evaluated further during the Phase 2 data analysis and presentation.	Appendix F - Attachment F1 presents a detailed analysis of the geochronological data collected during the RI investigation. Appendix G - Section 3 presents an integrated analysis of sediment transport that incorporates multiple LOEs, including geochronology.

Table A1. Comments on the Phase 1 Site Characterization Report Deferred to the RI Report

Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
234	Appendix O	Appendix O "Overall Interpretation of Lower Berry Creek" Second Paragraph: The report states that Lower Berry's Creek has a relatively "higher sedimentation rate." However, the core that used as an example (101) is not datable since pre-1950 material (non-detected Cs-137) was placed on top of post-1950 material (Cs-137 bearing) indicating a physical discontinuity in the core.	Based on the subsurface sediment profiling conducted nearly continuously along the entire length of all four study segments, the post-Pleistocene sediment thickness in LBC is clearly the greatest. The diversion of most freshwater and tidal flow from LBC following construction of the canal in 1911 reduced stream competence (power) and capacity of LBC, resulting in conditions favorable to net deposition. Also, the deposition of landfill debris along most of LBC during the 1950s, 1960s, and 1970s likely complicated the depositional profile in various ways. Such known factual events must be taken into account when interpreting the sediment cores. Nondetect results for ^{137}Cs do not automatically indicate that the associated sediment was deposited before 1954. Theoretical and observed profiles of ^{137}Cs, such as in Zapata (2002), show that deposited ^{137}Cs activities decrease steadily in more recent time. Hence, we would suspect that shallow samples, assuming they represent recent sediment, would have relatively low ^{137}Cs. Additionally, the highest sand fraction observed in the core was found in the 0–10 cm horizon of this core; as ^{137}Cs does not strongly sorb to sand, sediment grain size may have contributed to the nondetect result for ^{137}Cs in this sample. Following completion of Phase 2, a more substantial vertical characterization of sediments will be available to understand the general patterns and localized variations, to the extent needed to calculate risks and evaluate remedial alternatives. These results will be discussed further in the Phase 2 Report.	Appendix F - Attachment F1 presents a detailed analysis of the geochronological data collected during the RI investigation. Appendix G - Section 3 presents an integrated analysis of sediment transport that incorporates multiple LOEs, including geochronology.
235	Appendix O	Appendix O "Overall Interpretation of Lower Berry Creek" Third Paragraph: The report states that the mudflats have higher sedimentation rates than the channel. However, the two cores that they use as examples (116 and 117) are not datable since pre-1950 material (non-detected Cs-137) was placed on top of post-1950 material (Cs-137 bearing), which indicates a physical discontinuity in the core.	Please refer to the response to Comment #234 regarding dating of cores with nondetect ^{137}Cs results. TBZ-115, TBZ-116, and TBZ-117 present a coherent picture of the morphological history of the associated transect across LBC. Appendix O of the Phase 1 Report (Attachment O1) describes the relationships among the three cores in detail. To summarize, TBZ-115 represents the oldest portion of the sediment column, TBZ-116 represent sediment of intermediate age, and TBZ-117 represents the youngest sediment. Multiple LOEs, including COPC distributions, reasonably concurring ^{137}Cs and ^{210}Pb deposition rates, and the environmental setting of these coring locations, support that the thalweg may experience no net deposition. However, significant deposition may occur on mudflats, as evidenced by calculated deposition rates for TBZ-116 and TBZ-117 ranging from 0.9 to 2.2 cm/yr. This observation is consistent with the substantially reduced flows (i.e., stream power) in LBC since the construction of BCC in 1911. Comments regarding interpretation of geochronology data will be considered further during the Phase 2 data analysis and presentation.	Appendix F - Attachment F1 presents a detailed analysis of the geochronological data collected during the RI investigation. Appendix G - Section 3 presents an integrated analysis of sediment transport that incorporates multiple LOEs, including geochronology.
236	Appendix O	It is noted that 137Cs activity in a core was shown to have anomalies from storm activity and fine grained material had different activity than coarse grained material (Chmura and Kosters 1994). Were anomalous storm deposits identified in any of the cores?	Identification of storm deposits is not a specific objective of the Phase 1 or Phase 2 sediment program. Grain size analysis was completed for 10 cm sample intervals during Phase 1; however, much higher resolution analysis would be required to characterize deposits from individual storm events. Additional grain size data will be collected in Phase 2, but not at sufficient spatial or vertical resolution to conclusively identify specific storm-related deposits. The Group recognizes that grain size may influence the measured radionuclide activity (i.e., sand typically has a lower activity than finer grained sediment). This was generally noted in the introduction (Appendix O, page 2-2) and specifically discussed for several of the Phase 1 cores (e.g., TBZ-127, TBZ-142, TBZ-169, etc.). All potential explanations for the observation of ^{137}Cs nondetect values, including both grain size and storm-related deposition, will be considered during the analysis of Phase 2 geochronology data.	Appendix F - Attachment F1 presents a detailed analysis of the geochronological data collected during the RI investigation.

Table A1. Comments on the Phase 1 Site Characterization Report Deferred to the RI Report

Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
237	Appendix O	The existence of a subsurface peak shows that not all the sediment deposited since 1963 has been scoured away, but some of it may have been, i.e., contamination may have been remobilized. To assess uncertainty, visual inspections of the cores should be used to look for evidence of scour (e.g., discontinuities in color or texture). Also the computed sediment fluxes based on core deposition rates should be compared with those based on runoff modeling and TSS data at the Hackensack confluence.	A major objective of the Phase 2 field work and data analysis is to use all of the data, the understanding of the physical system, and the history of events in the BCSA to develop an in-depth empirical understanding of the sediment transport, deposition and resuspension dynamics. Included in this analysis will be detailed evaluation of the cores collected during the scoping, Phase 1 and Phase 2 work, as well as the SPI work.	Appendix F - Section 3.2 and Appendix G - Section 3 present the Group's analysis of sediment transport and deposition in the BCSA. Attachment F1 includes a core-by-core interpretation of high resolution cores collected during the RI.
238	Appendix O	p. 2-3: The list of cores with no net deposition currently includes 5 cores (115, 127, 141, 159, and 169), but should also include 128 according to its description in Attachment O-1. 108, 142, and 149 (Cs all ND below the top 2 samples) seem to have very little deposition, if any, and should be mentioned here as well (in 108, 137Cs horizon is at about 15 cm depth, but PCB concentrations are around 0.1 to 1 ppm prior to that, so there's no clear pattern of burial).	The data presentations for TBZ-128 in Appendix O were in error. The corrected ^{137}Cs dataset, which was shown in Figure O-2 and elsewhere in Appendix O and the report, indicates detected values and a coherent record of sediment deposition. The geochronology findings will be further evaluated as part of the Phase 2 analysis and the corrected core profiles for TBZ-128 will be provided as part of the Phase 2 Report. For TBZ-108, TBZ-142, and TBZ-149, it is recognized that in each case, the column of recently deposited sediment is thin and overlies sediments that may be much older. Yet, in all three cases, two separate LOEs (^{137}Cs and ^{210}Pb dating) indicate positive rates of deposition. Hence, it is not appropriate to classify these cores as experiencing no net change. Comments regarding interpretation of geochronology data will be considered further during the Phase 2 data analysis and presentation.	Appendix F - Section 3.2 and Appendix G - Section 3 present the Group's analysis of sediment transport and deposition in the BCSA. Attachment F1 includes a core-by-core interpretation of high resolution cores collected during the RI.
239	Appendix O	The term "dynamic" should be inserted before "equilibrium" when referring to cores or regions of the river that show recent sedimentation but no long-term trends. This will help emphasize that there are both erosional and depositional processes at work. For areas where there is not Be-7 data indicating recent deposition, what empirical evidence is there for equilibrium as opposed to net erosion? If none, then should be separated out from those that do have evidence of recent deposition (i.e., there should be an "indeterminate" or "potential erosion" category in addition to the equilibrium and depositional categories).	Please refer to the response to BCSA Group's original response to Comment #8 (Attachment A2) regarding characterization of depositional environments. The Group will consider this comment and the terminology used to characterize each sample location based on a review of the combined Phase 1 and Phase 2 geochronology data in the context of other LOEs related to sediment deposition. A detailed discussion of sediment deposition in the BCSA will be included in the Phase 2 Report.	Please refer to Appendix G - Section 3.
243	Appendix O	The description of the coring work should include a discussion of how coring locations were selected and what these represent (i.e., present the rationale behind the number of cores and their placement). When analyzing the results, it would be helpful to discuss all the deep pool samples together and all the mudflat samples together, in order to help identify any trends. This would be useful in places like Section 2.1.4.3 in Phase 1 Report and Appendix O and especially moving forward into the Phase 2 work.	Please refer to the response to the BCSA Group's original response to Comment #14 (Attachment A20 and the Phase 1 Work Plan (Geosyntec 2009) for information regarding sediment sampling program design. The Group will consider this comment during analysis of the combined Phase 1 and Phase 2 geochronology dataset. A detailed discussion of sediment deposition patterns in the BCSA will be included in the Phase 2 Report.	Please refer to Appendix G - Section 3, Appendix F, and Attachment F1.

Table A1. Comments on the Phase 1 Site Characterization Report Deferred to the RI Report

Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
244	Appendix P	The Mill Creek Reference area contains mitigation sites where major changes to the wetlands had been made in 1988 (63 acres) and more recently in 2000 (140 acres). The following information taken from www.njmeadowlands.gov/environment/parks/mcm.html should be included in the discussion: "This 209-acre area was purchased by NJMC for preservation in 1996 from Hartz Mountain Industries. It was undeveloped and had experienced no direct industrial activities. A development of a 2,750 town homes had been proposed for the site. It had a dense monoculture of common reed (Phragmites autralis,) with very little open water and reduced tidal flow. In its former condition, there was little habitat diversity.	Additional information on the history of the wetlands mitigation work at the Mill Creek reference site will be included in the RI Report and other deliverables, where appropriate.	Inclusion of this information was determined to be unnecessary to support the RI analyses and findings. This information may be included in the FS, if appropriate.
245	Appendix P	In 1998, NJMC began wetlands enhancement activities at the site, including the re-establishment of tidal flows, creation of open water impoundments, grading to create low, high and upland marsh areas, and native replantings to attract a diversity of aquatic life and birds. It was the first wetlands enhancement project NJMC managed… "In 1999, the New Jersey Meadowlands Commission acquired 63 acres of the site known as the Western Brackish Marsh and 77 acres of the site known as the Eastern Brackish Marsh."	See response to Comment #244.	Inclusion of this information was determined to be unnecessary to support the RI analyses and findings. This information may be included in the FS, if appropriate.

Notes:

[a] Attachment A2 provides a compendium of Agency comments and BCSA Group Responses. This column presents the previous comment response for context.

[b] Parsons. 2010. DRAFT - Removal Action Report fo West Riser Tide Gate Sediment Removal Project, Wood-Ridge and Moonachie, New Jersey (USEPA No. NJD980529879). Prepared on behalf of: Rohm and Haas Chemicals LLC, An authorized signatory of Morton International, Inc.

Table A2. Comments on the Phase 2 QAPP and Work Plan Addendum Deferred to the RI Report

Document	Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
Phase 2 QAPP (FSP)	44	6 and 7	FSP Sections 6.0 and 7.0 (Tasks 5F and 6F): In comparing ecological data from Berry's Creek to reference areas, the BCSA Group should account for differences in habitat population survey statistics and bioaccumulation potential attributable to the relative abundance of invasive species (e.g., Asian shore crab, Hemigrapsus sanguineus) as that may operate as environmental stressors independent of contaminants. Refer to Reichmuth et al., "Differences in Prey Capture Behavior in Populations of Blue Crab in Contaminated and Clean Estuaries in New Jersey" in "Estuaries and Coasts" Vol. 32, No. 2, March, 2009.	Upon the completion of fauna surveys in the BCSA and reference sites, field data will be reviewed to assess the role of invasive species in either the BCSA or reference sites.	Invasive species were not observed during site surveys or sampling events.
Phase 2 Work Plan Addendum	1	General	The finding of elevated manganese at elevated levels in more recently deposited sediments warrants additional discussion. The agencies are unaware of any "new" sources of manganese which would be responsible for this phenomenon. Could this related to changes in oxygen levels in Berry's Creek coincident with improved sewage treatment? Perhaps comparison of manganese levels in the Berry's Creek ecosystem with more healthy oxygenated estuarine systems is warranted.	Review of the data identified some potential manganese source areas that will be evaluated further in Phase 2 (e.g., outfalls in UPIC and east side of Eight Day Swamp). In addition, as noted in the Phase 1 Report (Section 2.3.3.3, p. 2-4), manganese would preferentially accumulate in more oxygenated sediment areas, such as the less frequently inundated portions of marshes. This relationship will be evaluated further when the Phase 2 marsh data are available, including the exchange of surface water between marshes and waterways, as well comparative analysis with the reference sites which have varying degrees of sewage effluent influences.	Manganese was evaluated in detail in the Phase 2 Report, Appendix Q. Manganese is evaluated in the BERA and BHHRA. Manganese is evaluated in the context of redox profiles and, in turn, mercury methylation profiles in Section 4 of the RI Report.
Phase 2 Work Plan Addendum	14	3.2.1.2	Page 3-11, Section 3.2.1.2., first bullet: "For example, correlating mercury or methyl mercury in biota data with surface water mercury/methyl mercury is more valid if the surface water data represent the dissolved, as opposed to the total, fraction." For ecological receptors, the decision to use dissolved versus total metal data should depend on the potential exposure route. The dissolved fraction may be the best measure for an animal that would get the biggest dose from uptake across the gill or through the skin but the unfiltered may be best for an animal that would ingest water.	The ecological risk assessment will take into account the exposure route and whether dissolved or total concentrations are the most appropriate measure of dose.	Please refer to Appendix L - Attachments L4, L5, and L6.

Table A2. Comments on the Phase 2 QAPP and Work Plan Addendum Deferred to the RI Report

Document	Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
Phase 2 Work Plan Addendum	21	3.3.1	Section 3.3.1, Page 3-22 (Task 3A): Due to the potential for sediment transport due to storm events and anthropogenic activities, the deepest detection of Cs-137 in a particular core may not represent the 1954 horizon (although the sediments are certainly from 1954 or a more recent date) and the peak detection of Cs-137 in a core may not represent 1963 because the 'true' peak sediment may have been eroded or removed at some point. Discontinuous core profiles can confound attempts to estimate deposition rates and additional criteria for evaluation of profiles are required, for example, at least a 0.5 pCi/g detection of Cs-137 to confirm the presence of the 1963 sediment horizon. Changes in the Study Area watershed over history, including the construction of the Oradell Reservoir and increasing upland development, have likely contributed to changes in Pb-210 deposition and are likely to confound attempts to calculate deposition rates that assume constant deposition.	The influence of storm events and anthropogenic activities has likely affected the distribution of radioisotopes in the sediments in some locations in the BCSA. The Group is reviewing the several sources of data on the subsurface cores and will include consideration of the history of the events in the Hackensack River basin that have likely influenced the sediment accretion and resuspension over time.	Potential historical influences are discussed in RI Report - Section 4.1, Appendix B, Appendix F, and Attachment F1.
Phase 2 Work Plan Addendum	31	3	Page 3-34, Task 5A, COPC Residues in the BCSA Food Web: The work plan notes, "Additionally, data for mummichog and fiddler crab will support an evaluation of the quantitative relationship between measured sediment concentrations and biological tissue, given that both of these species exhibit a relatively high degree of spatial fidelity and therefore may be more reliably paired with sediment data to examine bioaccumulation relationships." Please provide supporting studies that show a relationship between sediment concentrations and mercury concentration in these biota.	The Group recognizes that the relationship between sediment concentrations of mercury and biota concentrations can be difficult to illustrate. However, additional data collected from a different year and season is needed to further examine the relationship in the BCSA. The results from Phase 1 and Phase 2 work will be presented in relation to the literature in the Phase 2 Report.	These results are presented in Appendix I - Attachment I6.
Phase 2 Work Plan Addendum	41	3.5.5	Section 3.5.5, Page 3-45 (Task 5E), First Sentence: The baseline ecological risk assessment (BERA) needs to include a benthic organism.	Tissue data are being collected from fiddler crabs and blue crabs. In addition, the benthic community surveys in Phase 2 will be used, in part, to determine if another benthic organism should be included in the BERA.	Sediment associated organisms (a variety of crab species) were sampled to support the BERA. Specific sampling efforts in Phase 3 were directed to collect infaunal organisms but not enough mass could be collected to support chemical analysis.
Phase 2 Work Plan Addendum	42	3.5.5	Section 3.5.5, Page 3-45 (Task 5E): The benthic community survey should include a triad sampling approach, which consists of a benthic community survey, sediment chemistry, and toxicity testing for each sampling location.	The use of the triad approach to sediment evaluation will be assessed following Phase 2, taking into account the benthic community survey results and the factors that would influence the use of toxicity testing (e.g., salinity patterns, DO patterns, substrate composition).	The triad analysis is presented in Appendix L - Attachment L9.

Table A2. Comments on the Phase 2 QAPP and Work Plan Addendum Deferred to the RI Report

Document	Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
Phase 2 Work Plan Addendum	45	3.5.6	p. 3-46, Section 3.5.6 Task 5F, Qualitative Survey of Invertebrate/Insect Community: Total Hg concentrations should be measured in insects during this phase since they will be collected.	To be meaningful in the ecological risk assessment, any measurements of mercury in the insects should be limited to the types of insects that are known to be prey of the measurement endpoint. Designing such a study first requires some field verification of insects present at the site and their variability over a couple of seasons (summer and early fall of this year) consistent with ecological risk assessment guidance. Therefore, the qualitative step will be completed first, along with the next stage of the risk assessment before determining what additional tissue samples may be needed to support the risk characterization.	COPCs in marsh invertebrates are discussed in Appendix I - Section 3.1.2.
Phase 2 Work Plan Addendum	48	3.6.1	p. 3-52: 3.6.1 Task 6A, Biota Sampling: Measured Hg and PCB tissue residues (and other bioaccumulative contaminants) should be compared in BCSA biota and other areas to effects thresholds in the literature as a line of evidence. Fish sampling for COPC analysis should be designed with seasonality in mind. Weis et al, 1986 found that monitoring of mercury levels of fish collected from Berry's Creek throughout the year revealed a 5-fold increase during the summer months.	The literature-based effects thresholds will be used as one LOE in the risk assessment. There are, however, important uncertainties associated with these values, and this uncertainty will be noted in the risk assessment. Fish tissue sample collection is proposed in the summer, to evaluate the anticipated higher fish tissue concentrations as described in Weis et al. (1986) and Weis and Ashley (2007). REFERENCE: Weis, P. and J.T.F. Ashley. 2007. Contaminants in fish of the Hackensack Meadowlands, New Jersey: Size, sex, and seasonal relationships as related to health risks. *Arch. Environ. Contam. Toxicol* . 52:80-89.	Please refer to Appendix L - Section 6, Attachment L6.
Phase 2 Work Plan Addendum	50	4	p. 4-1, Section 4, Ecological Risk Assessment Approach: For Risk Characterization it is unclear how the types of studies planned will be able to be tied to specific contaminants of concern or mixtures.	Measurement endpoint data will be evaluated in the context of COPC concentration data, consistent with EPA risk assessment guidance. Any observed changes in measurement endpoints will be analyzed in relation to gradients of conditions (CERCLA-stressors-COPCs, conventional parameters-DO, salinity, etc.). In addition, the data will be compared to concentrations and responses at reference sites, taking into account known mechanisms of toxicity and information that indicates the relative bioavailability of COPCs.	Please refer to Appendix L - Section 6.
Phase 2 Work Plan Addendum	51	4	p. 4-3, Risk Characterization: Were species of special concern identified?	Yes, for example the Least bittern. The species of special concern will be described in subsequent ecological risk assessment deliverables.	Please refer to Appendix L - Section 2.4.7.
Phase 2 Work Plan Addendum	53	5.3.2	Page 5-2, Section 5.3.2: The Draft BHHRA should include RAGS D Tables 1-10.	Agreed.	These tables are provided in Appendix M, as follows: RAGS D Table 1 - Table 3-1 and Attachment M4 RAGS D Table 2 - Attachment M1 RAGS D Table 3 - Attachment M4 RAGS D Table 4 - Attachment M4 RAGS D Table 5 - Attachment M2 RAGS D Table 6 - Attachment M2 RAGS D Table 7 - Attachment M4 RAGS D Table 8 - Not applicable RAGS D Table 9 - Attachment M4 RAGS D Table 10 - Tables 5-1 through 5-6 (modification of RAGS D format).

Table A2. Comments on the Phase 2 QAPP and Work Plan Addendum Deferred to the RI Report

Document	Comment No.	Section No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
Revised Phase 2 WP Addendum	27	3.7.1	Page 3-75, 3.7.1, last paragraph: EPA requests more details about the desktop study to estimate atmospheric loading to the BCSA.	The objective of the desktop study is to expand on the findings presented in Section 2.5 of the Phase 1 Report by providing a quantitative and media-specific accounting of the mercury and PCBs that enter the system from the regional airshed. Data sources to be considered in this analysis include measurements of mercury and PCBs deposition published in both peer-reviewed and agency documents (e.g., New Jersey Atmospheric Deposition Network, etc.). This information will be used to understand regional airshed contribution to chemical load in surface water and sediment. Regional atmospheric contributions to the BCSA are reflective of urban background and will continue to influence surface water and sediment concentrations following remedial actions. This information will be considered during the analysis of remedial alternatives at the site.	Please refer to Appendix O.
Revised Phase 2 WP Addendum	28	3	Page 3-78, 3rd paragraph: A kayaker was identified as the most highly exposed pathway above the surface waters in BCSA. Swimming was identified as a future exposure pathway. EPA suggests collecting ambient air data at the proposed 1 m. height in addition to just above the water surface (5 cm.) as would be an appropriate breathing zone for a swimmer.	As discussed and agreed upon during our meeting with EPA in Edison, New Jersey on February 24, 2011, the Group will evaluate potential exposures to an overboard kayaker and swimmer by modeling air concentrations in the breathing zone near the air-water interface. A conservative modeling approach will be used to ensure that potential exposure concentrations are not underestimated.	These exposure scenarios are evaluated in Appendix M.

Notes:
[a] Attachment A2 provides a compendium of Agency comments and BCSA Group Responses. This column presents the previous comment response for context.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
1	Further information regarding the data treatment decisions (e.g. treatment of below detection limit data, how data were grouped and/or averaged, number of samples, whether samples collected in different seasons are grouped) should be included for the analyses presented and for those analyses that were done but not presented. It may also be useful to provide the rationale and if available, supporting data, for each relevant data treatment decision. Since work was done to come up with the best analyses, the supporting information showing why analyses conducted were not included and why the results presented were selected would be helpful. The analyses conducted but omitted could be included as a separate appendix.	Additional information regarding data treatment will be included for each type of analysis presented in the RI Report. The more detailed graphical, tabular, and/or statistical analyses that provide further support for the findings presented in the RI Report will be included as appendices. A variety of graphical, tabular, or statistical approaches are explored during preliminary data analysis, and many are determined to not be suitable or appropriate (e.g., inappropriate statistical tests given data distribution), or do not provide any more meaningful insight into the BCSA physical, chemical, or biological systems compared to the analyses that are presented. Substantial effort and page space would be required to provide a detailed discussion of all such analyses. In presentations to the EPA, the BCSA Group will explain why it has selected to present the data in a particular manner. These analyses and the RI findings will be discussed with EPA, and then if necessary, the BCSA Group will complete additional analyses using alternate approaches the EPA puts forth.	Appendix K - Attachment K2 presents the data treatment methods employed in the RI.
2	While EPA believes that overall the data presentation is logical and adequate, some reviewers thought additional presentation would be helpful. Although the Phase 2 conclusions are bulleted in Section 2, the presentation and discussion of the data to support the conclusions presented could be improved. It would be useful to include comprehensive summary sampling tables for each of the geographic areas which provide the matrix sampled, number of samples, sample dates and mean, median and range of the concentrations.	The requested summary tables for each study segment (LBC, BCC, MBC, UBC) and the reference sites will be included in the RI Report.	Please refer to: Surface Water: Appendix E - Attachment E3 Sediment: Appendix F - Attachment F3 Biota Tissue: Appendix I - Attachment I3.
3	Mercury and methylmercury are present at elevated levels in sediment, surface water and biota in the BCSA. The most elevated concentrations are present upstream closest to the mercury source area. Total mercury concentrations, which include the relatively immobile inorganic mercury, decrease in concentration downstream in the BCSA system. Methylmercury, which is more mobile and bioavailable, is present at more consistent concentrations from upstream (source) to downstream in the LBC. The literature generally recognizes that highest levels of mercury methylation occur in marshes that are subjected to frequent wetting and drying periods. This should be recognized and discussed. (Alpers et al. 2008; Ackerman and Eagles-Smith 2010; Foe et al 2008; Wood et al 2010; DiPasquale et al 2009).	The BCSA Group agrees that: mercury and methyl mercury along with other COPCs are elevated in the upper reaches of the BCSA; the upper part of the system includes several sites that handled mercury including the Ventron Velsicol site; and the mercury concentrations generally decline moving north to south in the BCSA. Note that mercury, along with many other COPCs, had many uses and users in the past. A more detailed discussion of methyl mercury mobility is provided in the response to Comment 4. Comment 3 links patterns in the mercury data in the BCSA with certain referenced literature, stating that these are generally recognized processes, and implying therefore that wetting and drying must be an important process at work in the BCSA. However, consideration of generalizations from other sites with respect to the site-specific BCSA conditions requires detailed analysis; otherwise, decisions made may not reflect site-specific factors or processes. The BCSA Group's consultant team and Technical Committee have examined the referenced papers identified in the comment. While the papers support that, for sediment in certain systems, "wetting and drying periods" are a factor to be considered in methyl mercury distribution, the tidal nature of the BCSA marshes, and the high percentage of organic matter and fine particulates in the BCSA marshes, means that the BCSA sediments are always wet (saturated or a high percent moisture). The BCSA sediments and marshes do not dry like the floodplains or intermittently flooded areas studied in the cited literature. In fact, the Alpers et al. (2008) study indicates the lower elevation tidal marshes that are inundated daily, like much of BCSA, tend to have lower concentrations of methyl mercury, similar to some findings of Foe et al. (2008) and Wood et al. (2010). These findings in relation to the BCSA marshes reinforce the need for a detailed site-specific analysis of the data, and that unsupported generalizations should be avoided.	These topics are discussed in Appendix F - Section 4 and Appendix H - Section 2.4.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
3 [cont.]		The need for and type of additional studies will be evaluated again in scoping of any additional Phase 3b studies for the 2014 field program, which the EPA will review and approve prior to implementation. The potential relevance of wetting and drying of BCSA marshes, along with the other factors that potentially affect methyl mercury concentrations in the BCSA, will be discussed in relation to the site-specific information. The RI and FS Reports will provide a comprehensive evaluation of the multiples LOEs, including patterns, trends, and hydrodynamics, that must be understood to evaluate the range of site-specific remedial alternatives that should be considered in the BCSA.	
4	The report acknowledges that mercury concentrations in sediment and water are highest in the UBC, and decrease downstream, with weather and tides influencing the concentrations and slope of the concentration gradient. It also acknowledges that concentrations of methylmercury do not decrease as much downstream, and there is a more equal distribution. The primary explanation in the text is that there are factors that limit the bioavailability of mercury for methylation. However, another possible reason is that methylmercury is more mobile in an aquatic system and is migrating downstream in the system from the upstream sources where mercury is at higher concentrations. This should be discussed.	Downstream transport of methyl mercury in the water column is suggested in the comment as an alternate primary explanation for the distribution pattern of methyl mercury in BCSA waterways. At any one point in the BCSA there are multiple physical, chemical, and biological factors that influence the methyl mercury concentrations, and the relative influence of these factors varies over the range of conditions that occur. The Phase 2 Report recognizes these multiple factors. The report points out the relative similarity in the waterway methyl mercury levels across the BCSA study segments, despite differences in total mercury, and states that this is due to several factors, including low bioavailability of BCSA mercury due to elevated concentrations of AVS and TOC; and biogeochemical conditions (e.g., redox) in the shallow waterway sediments that limit methyl mercury production to discrete depth intervals. These are recognized in the site-specific mercury CSM (Section 2.3.7.1). In addition, the CSM states the fate and transport of mercury and methyl mercury in the BCSA are a function of both the physical characteristics of the estuary and the chemical processes described above that affect mercury form and speciation. The primary mechanisms by which mercury and methyl mercury are transported within the BCSA are movement of surface water and associated suspended sediment due to tidal action and exchange of marsh porewater due to interflow discharge and diffusive exchange. With respect specifically to methyl mercury migration in the water column, waterway transport appears to be of relatively small importance in explaining the methyl mercury distribution in surface water from the north end to south end of the BCSA site. Several LOEs support this; for example, considering the relatively high variability of hydrologic conditions from neap to spring, combined with the range of precipitation events encountered over the monitoring period, the apparently lower variability in methyl mercury concentrations along the north to south gradient would not support waterway transport as an important process at work in the BCSA. Further, the upstream portion of the study area has been shown to be highly retentive of particulates, making downstream transport an unlikely explanation of the observed pattern of methyl mercury concentrations in surface water. For these reasons, the Phase 2 Report focused on differences in bioavailability and biogeochemical conditions along the gradient. Data to date support that differences in these factors are strongly controlling methyl mercury concentrations in the BCSA. For example, the sequential extraction studies done by the Group indicate that large percentages of mercury are in forms that are not bioavailable, particularly in the upper reaches. This is consistent with other LOEs such as the AVS-SEM data. The Group will further evaluate, and the RI Report will fully discuss, transport and fate of COPCs, including mercury and methyl mercury. The discussion will address methyl mercury transport in the water column, using all of the relevant LOEs available, including factors such as the solubility of inorganic mercury and methyl mercury, the potential for downstream transport of both, methylation and demethylation, and the relatively short half-life of methyl mercury in water due to UV and biological degradation.	Please refer to RI Report - Sections 5 and 6.2; and Appendix H - Sections 2.4 and 3.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
5	The Phase 2 Site Characterization Report includes a Regional Background Evaluation which determined the regional concentrations of the contaminants of potential concern (COPCs) in the area around the BCSA. Further information should be provided regarding how these data will be used (e.g., will they be used in the Ecological Risk Assessment).	Regional background data will be used in the risk assessment along with BCSA-reference site data to support estimates of regional risks. The risk assessment will evaluate risks associated with COPCs in BCSA samples and additionally in samples collected from BCSA reference sites. Regional background data from the broader region also will be used as a point of comparison for the risks in the BCSA and the BCSA reference sites. This evaluation will be done to place site-specific risks in an appropriate regional context. This information will then be used during the evaluation of remedial objectives and alternatives, and eventually when making risk management decisions for the site. This approach is consistent with EPA Contaminated Sediment Management Guidance.	The analysis of regional conditions is presented in Appendix J. Appendices L and M include consideration of regional conditions in the evaluation of site risks.
7	Given that the Phase 2 Site Characterization Report describes the remedial investigation to date, it is premature to include statements that could be considered conclusions regarding the effectiveness of specific remedial options. For example, on the second paragraph on page 1-9, under Study Question No. 4, the Phase 2 report reads "Multiple lines of evidence support the burial of COPCs by cleaner sediment is facilitating natural recovery." Statements regarding natural recovery should wait until the Feasibility Study.	The Phase 2 Site Characterization Report included a detailed analysis of the horizontal and vertical distribution of COPC concentrations in sediment, as well as sediment deposition in the waterways and marshes. It is therefore appropriate to include an evaluation of these data to assess the extent to which natural recovery is occurring in the BCSA. An evaluation of monitored natural recovery as a potential component of the remedy for the site will be included in the detailed alternatives analysis and the FS, as appropriate.	RI Report Section 6.5 and Attachment F1 present an analysis of natural recovery of BCSA site sediment.
8	Presentation of Averages: Care should be taken to ensure that the development of average concentrations and their use in drawing conclusions does not bias the findings. Some examples are provided below:	The RI and Baseline Risk Assessment Reports will include evaluations of spatial and temporal patterns to the data. The implications of these patterns in defining the extent and risk significance of the data will be fully explored in these reports as well as the risk analysis of alternatives.	Please refer to: Appendix E - Section 4 Appendix F - Section 3 Appendix I - Section 3 Appendix L - Section 6 Appendix M- Section 5.
8a	a. Figure 2-38c: A waterway Total PCB average concentration of approximately 68 mg/kg is indicated in the surface of MBC-Ackermans. However, when the data for MBC-Ackermans on Figure J-34 are examined, only 3 of the 11 surface waterway points (550, 122 and 37 mg/kg, respectively) have concentrations that fall above 9 mg/kg. Consequently, the average of 68 mg/kg is not indicative of the overall conditions in the surface sediment of MBC-Ackermans, yet it is being used to compare the surface conditions in MBC-Ackermans to the other presentation areas and in the development of conclusions.	The comment is noted and demonstrates a drawback of the use of arithmetic averaging for potentially asymmetric datasets such as this. More refined methods of data analysis and presentation have been employed, such as the format involving data ranges in Figure 2-41. The Group has endeavored to balance the need for more detailed presentations (e.g., plots showing the results of all samples in a given reach) with the need for more simplified presentations, such as Figure 2-38c, in other cases. The latter approach has the advantage of more rapidly conveying broad lateral and vertical patterns in the data. As in the Phase 1 and Phase 2 Site Characterization Reports, the RI Report will include multiple methods of data presentation, with varying levels of complexity, to meet the varying needs for depiction of broad patterns in some cases with more detailed data presentation and analysis in other cases.	Appendix F - Section 3 presents a detailed description of the distribution of COPCs in site sediment.
8b	b. Table 2-4: The footnotes indicate that tabulated data represent the average of multiple sampling events (i.e., Quarter 1 and Quarter 2). Please revise table to show the two sampling events separately. Also, please fix the typo in Footnote B, which suggests that all of the surface water data are unfiltered.	The data presented in Table 2-4 will be presented in the RI Report and will be revised as appropriate to address the agency's comments. Please note that the footnote is correct; unfiltered surface water data were used in the comparison.	Appendix E - Section 4 presents an analysis of marsh interflow, including a comparison of COPC concentrations in marsh interflow seepage to surface water.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
9	Page 1-6, First Paragraph under Study Question No. 2: Please clarify the impacts of storms on the resuspension of surface sediment. If deposition in the BCSA is estimated at 10 cm per 40 to 50 years, or 0.2 to 0.25 cm/year, then a storm that resuspends the "top few centimeters" can easily resuspended and transport sediments that had accumulated for the past 15-25 years. Please address the effects of resuspension in the BCSA on surface sediment concentrations, especially since Study Question No. 1 (second full paragraph on Page 1-6) indicated that a strong correlation exists between surface sediment concentrations and surface water concentrations normalized to suspended solids.	For context, the statement in comment 9 is provided below. "The sources of stressors in relation to the receptors are better understood following Phase 2. Historical industrial discharges contributed a substantial mass of COPCs to the BCSA, including mercury, TAL metals, PCBs and other compounds. Most of the mass of COPCs is buried under layers of cleaner sediments (greater than 10 cm in most areas over the last 40 to 50 years). The top few centimeters of the surface sediments are subject to resuspension only during major storm events, such as Hurricane Irene in 2011, which had an estimated return frequency of one in eighty years. Consequently, COPCs from historic sources are largely unavailable due to physical isolation. In addition, many of the COPCs are typically associated with the inorganic fraction of sediments and suspended solids, which are highly retained in the BCSA." The first paragraph under Study Question No. 2 (quoted above) states the high concentration COPCs from historic sources are largely unavailable due to physical isolation as only the more recent, lower concentration, sediment are resuspended, even during large storm events. The net effect of storm-related resuspension is the subject of additional evaluation, including specific sampling work in Phase 3b (2013). Nonetheless, the analysis conducted to date indicates sediment resuspension effects in the BCSA are likely minimal on surface concentrations. The resuspended BCSA sediment during storms undergoes a mixing and re-deposition process with a proportionately large influx of relatively clean sediment into the study area during storm events, from the uplands, the downstream estuary, or both. This topic, including issues raised in EPA's comment, will be evaluated in detail as part of the fate and transport analysis and fully discussed in the RI Report.	These topics are discussed in the following locations: RI Report - Section 6.2 Appendix E - Section 4.3 Appendix F - Section 3 Appendix G - Section 3.
10	Page 1-6, SQ No. 2, first paragraph and page 1-9, Last Paragraph (SQ No. 4): The report presents the finding that COPCs are associated with inorganic sediments. At many sediment sites the COPCs are proportional with the amount of organic material in sediment. Please provide supporting discussion about this finding given that it is contrary to the expected finding.	The referenced text on page 1-6 was intended to convey that a large percentage of the mass of many of the COPCs (e.g., mercury, chromium, cadmium, and zinc) is present in inorganic mineral forms, such as inorganic sulfide minerals, particularly in bedded sediment. The referenced text on page 1-9 was intended to convey that, although *Phragmites* detritus from the marshes is a substantial source of organic particulate to the waterway and to the overall sediment balance, *Phragmites* detritus is low in COPC concentration and thus does not represent a substantial source of COPCs to the BCSA water column and sediment. It is acknowledged that several of the COPCs preferentially partition to organic matter and that this process must be considered in the evaluation of COPC transport and fate in the BCSA. The RI Report will provide a detailed discussion of these topics, referencing supporting data and literature where appropriate. COPC distribution within the various media (sediment, water, plant tissue, and biota) and amongst organic and inorganic fractions of these media will be discussed. The primary mechanisms that contribute to the transport, attenuation, and fate of COPCs (e.g., mineral precipitation/dissolution, partitioning, volatilization, transformation reactions) will be identified and evaluated.	These topics are discussed in multiple locations in the RI Report, including: RI Report - Sections 5 and 6 Appendix E - Section 4 Appendix F - Section 3 Appendix H - Sections 2 and 3 Appendix I - Section 3.
11	Page 1-11, Second Paragraph under Study Question No. 6: Please provide data (or cross-reference an appendix or figure) to supports the following statement: "…the amount of waterway sediment redistributed during this storm event was less than the amount of sediment estimated to be deposited during…data collection (22 months)".	Section 2.2.2.2 "Sediment Balance" presents the methods for determining the net sediment fluxes in the system, with supporting calculations presented in Appendix B. The cumulative fluxes show a net accumulation of inorganic sediment over the 22-month long period of measurement, including Hurricane Irene. The RI Report will include further evaluation and detailed presentation of the flux calculations, including sensitivity and uncertainty analysis on all input data and incorporation of Phase 3 data (e.g., the particulate organic carbon study, uplands runoff study).	Appendix G - Section 3 discusses sediment transport in the BCSA based on multiple LOEs collected during the RI. Attachment G3 details the sediment flux calculations and analyses.
14	**Page 2-13, Section 2.2.1.4, First paragraph:** Please add a short description or footnote regarding the methods used during the remedial investigation to measure flow.	Freshwater baseflow was directly measured in upland tributaries as described in Section 2.2.1.2.2 and SOP 1.5. In addition, freshwater baseflow was calculated based on the net seaward water flux (excluding storm water runoff inputs) measured at each of the moored stations. Integration of the calculated water flux over the 22-month long monitoring period shows, as expected, a net flow of water out of the BCSA. This flux, less the total storm water runoff (estimated based on runoff modeling; see Section 2.2.1.2.2), corresponds to the freshwater baseflow. The RI Report will include a revised water budget, including additional data collected during Phase 3. The revised water budget will include refinement of the estimate of base flow and will present the water budget for the range of flow conditions requested in Comment 18.	Appendix D - Sections 2 and 3 present the analyses of freshwater inflows to the BCSA tidal zone. Attachment G2 presents the revised water budget/balance analyses. Attachment G3 presents the analyses of water flux based on the moored station data.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
15	**Page 2-14, Section 2.2.1.5, Second paragraph:** Several rates of evapotranspiration are referenced. Please explain how the average value of 10,725 m3/day was derived.	The average value of 10,275 m^3/day was estimated based on an assumed annual average evapotranspiration rate of 2.75 mm/day. This rate was selected as representative based on the range of rates cited in literature and summarized in Section 2.2.1.5. The evapotranspiration rate will be reevaluated as part of the revised water budget in the RI Report.	Please refer to Appendix G - Section 2.2.1 and Attachment G2.
16	**Page 2-18, Section 2.2.1.8.1, Second paragraph:** Please define the term "depth averaged velocities" and please differentiate this term from "average velocities" as stated in the last sentence (perhaps the phrase "average velocities over time" may help). Also, it is important to know the specific bottom velocities to understand shear stress.	The depth averaged velocity is an average of all of the binned velocities at specific depths from the ADCP. The average velocity is the temporally-averaged velocity magnitude over a tidal cycle. It is agreed that bottom velocities are an important consideration to understanding shear stress. In recognition of this, near-bed velocities were directly measured at representative locations and morphologies during Phase 2 using near-bottom platforms, and these data related to shear stress. The bottom measurement from the ADCP profiler may be used to further investigate shear stress for the RI Report. Additionally, hydrodynamic modeling investigations are underway to evaluate shear stress throughout the system.	Please refer to Appendix G - Section 2.5 and Attachment G3.
17	**Page 2-20, Section 2.2.1.8.2, First paragraph, Second to last sentence:** The Phase 2 Site Characterization Report states that "the larger the [storm] events are, the more they can increase the channel velocities." The relevance of this should also be clarified. For example, "…higher channel velocities have the potential to resuspend more sediments."	The direct quantitative evaluation of resuspension of sediment in the waterways during storm events is ongoing with further analysis of the Phase 2 and 3 data, including cores, water column fluxes, and other lines of evaluation. These will be presented fully in the RI Report.	Sediment resuspension under tidal and storm flow conditions is discussed in Appendix G - Sections 2.5, 3.1 and 3.4 and Appendix E - Sections 3.5 and 4.3.
18	**Page 2-22, Section 2.2.1.9, General Comment:** A summary table presenting the range of budgets for different flow conditions would be informative to understand the water budget.	The water budget will be revised based on the additional data as part of Phase 3, which will refine the uplands flow and waterway flux quantification. A tabular summary will be presented, to the extent it can be representative of the range of flow conditions in the water budget evaluation. These will be presented fully in the RI Report.	The final water budget is presented in Appendix G - Attachment G2.
19	**Page 2-22, Section 2.2.2, First paragraph:** The introduction to Section 2.2.2 "Sediment Transport" states that "This section focuses on incorporating the understanding of hydrodynamics … to characterize sediment transport." To assist with this understanding, please include a discussion of bottom velocities and shear stresses under different flow conditions and how that impacts sediment resuspension. (Please include a similar discussion in Section 2.2.2.3.3 "Sediment Resuspension".)	The RI Report will include a revised CSM of the physical system and will include data-based calculations and model predictions of bottom velocities and shear stress, and an analysis of the related implications on sediment resuspension. This will include an analysis of spatial patterns through the system over a range of conditions.	Appendix G - Section 3 presents a detailed discussion of sediment transport in BCSA based on multiple LOEs. Attachment G3 presents many of the detailed analyses performed to support the sediment transport CSM.
20	**Page 2-26, Section 2.2.2.2, First paragraph, First sentence:** Please specify what measurements (e.g. velocity, solids, etc.) are being referred to in the first sentence. For the rest of Section 2.2.2.2, please specify whether information is calculated or measured. For example, measurements and calculations are conflated in places, and in other places, it is just not clear which is being used. The appendix does not need to be repeated, but please provide the methods used for calculations and what measurements the calculations are based on. For example, Page 2-28 (Section 2.2.2.2.2, Second paragraph, First sentence) provides a specific instance where information described as measured was previously referred to as calculated.	In the sediment balance provided in Section 2.2.2.2 "Sediment Balance," the methods for determining the net sediment fluxes in the system are outlined. Detailed calculations supporting the sediment flux analyses are presented in Appendix B. Further evaluation of the flux calculations, including sensitivity and uncertainty analysis on all input data and incorporation of the Phase 3 data (e.g., the particulate organic carbon study), will be presented in the RI Report. An important component, spatial variability, is being evaluated with ongoing Phase 3 studies and will be fully presented in the RI Report. These presentations in the RI Report will include greater specificity with respect to what measurements or calculations are being referenced.	Please refer to Appendix G - Section 3.2.3 and Attachment G3.

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Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
22	**Page 2-28, Section, 2.2.2.2.2, Mathematical Equation:** (1) The uncertainty of the numbers used in this equation should be presented; (2) Is it possible at this time to expand the "Sediment In" term to include how much material is being deposited in the marshes and how much to the open waterway?; and (3) Please clarify whether the solids input to the BSCA represents upland sources only or if it includes solids from the estuary.	Section 2.2.2.2 "Sediment Balance" presents the methods used to determine the net sediment fluxes in the system, with further calculations presented in Appendix B. The sediment input to the BCSA includes both uplands and estuarine inputs. Further evaluation of the flux calculations, including sensitivity and uncertainty analysis on all input data incorporating Phase 3 data (e.g., the particulate organic carbon study), will be presented in the RI Report. An important component, spatial variability (including analysis of sediment accumulation within specific morphologic features and including marshes), is being evaluated at present with the ongoing Phase 3 studies. These analyses will be fully presented in the RI Report.	Appendix G - Section 3.2.3 and Attachment G3.
23	**Page 2-32, Section 2.2.2.3.2, Third Paragraph:** The Phase 2 Site Characterization Report states that "high-resolution waterway testing…demonstrated the ongoing recovery of COPCs in sediment in recent decades through continued deposition." Please quantify the reduction in concentrations. A table with average decadal concentrations per contaminant would be useful here to the discussion.	The Phase 1 Site Characterization Report (BCSA Group 2010) presented figures (e.g., Figure 2-33) that depict ratios of surface to subsurface sediment concentrations. This analysis pre-dated the high-resolution sediment core work but provides an initial assessment of the topic requested by the reviewer. The Group is evaluating refined methods of quantifying concentration reductions for various time horizons for the RI Report. However, the BCSA Group does not at this time recommend attempting quantification of average decadal concentrations; this would require the assignment of decade-by-decade age ranges to sediment core intervals across the dataset, although it can extrapolated generally. Due to the considerable variability in historical depositional patterns across the BCSA (i.e., varying depositional rates and temporal patterns thereof), the available data and associated analyses are not likely of the precision sufficient to support such assignments but will be considered further during the RI analyses of natural attenuation.	Please refer to RI Report - Section 5.1 and 6.5; and Appendix F - Section 3.4 for a detailed discussion of COPC concentrations with depth in sediment and natural recovery. For the reasons noted in the original comment responses, the Group has not assigned decadal age ranges to sediment core intervals.
24	**Page 2-34, Section 2.2.2.3.3, Last paragraph:** This discussion on sediment resuspension should also consider shear stresses generated during Hurricane Irene (and in the future will have to compare to sheer stresses from Superstorm Sandy). If shear stresses were increased a little due to these storms, the conclusion that the deeper sediment bed would not be eroded may not hold. Please expand the discussion of analyses to summarize all locations where Sedflume cores were tested.	The following presents the paragraph referenced by the comment 24: "Near-bed ADV measurements of shear stress and Sedflume measurements of critical shear stress were plotted together for in-channel (Figure 2-20a) and mudflat (Figure 2-20b) locations adjacent to MHS-07 in UBC. Figure 2-20a shows that the measured shear stress in the channel during a large spring tide exceeds the red line which represents the critical shear stress at the surface (0.19 Pa). This shows that resuspension of the fluff layer at the surface is possible at this location under spring tide conditions. The observation that the shear stress does not exceed the critical shear stress of the next depth interval tested illustrates that only the low density fluff material at the surface (on the order of millimeters thick) would be mobilized. As shown in the near-bed ADV platform data, this material deposits back to the sediment bed as the velocities and shear stresses drop. Figure 2-20b shows that the measured shear stresses at the mudflat location are lower than the critical shear stress of the sediment bed at this location. Overall, the qualitative comparison of shear stresses at the surface of the sediment bed with Sedflume-based measurements of critical shear stress for erosion illustrates the potential for resuspension of the thin fluff layer, but not of deeper consolidated sediments." The analyses that are the subject of this comment (comparison of ADV shear stresses, Sedflume data, flux data, etc.) represent a screening level evaluation completed to support the CSM development. This screening evaluation does not fully take into account other factors that relate to sediment resuspension. Ongoing analyses being completed as part of Phase 3 and the RI reporting will consider factors such as: • Shear stress distributions during different events • Effects of high sediment loading to the system on resuspension capacity • High localized shear stress related to surface water inputs • Reduction in channel shear stress due to high water levels (as is discussed in response to comment 21)	Please refer to Appendix G - Section 3 for a comprehensive discussion of sediment transport in BCSA; as well as Attachments G3, G9, and G10 for detailed presentation of the near-bed ADV monitoring, SEDflume, and sediment transport modeling.

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Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
24 [cont.]		• Bed coarsening due to high storm-related bedload input and resulting reduction in erosion potential of the sediment bed, and • Spatial variability in sediment properties and hydrodynamics. Ongoing work includes an integrative analysis of multiple factors to explicitly address the transport potential of storms as related to the sediment bed and address important questions such as: • How do the shear stresses observed and predicted compare to the Sedflume data? • How do these data line up with measured sediment fluxes during Hurricane Irene? Ultimately, the RI Report will include a full evaluation of the significance of storm events with respect to sediment resuspension and, in turn, COPC transport and fate.	
25	**Page 2-34, Section 2.2.2.3.3 and Figure 2-20:** In Figure 2-20, the critical shear stresses provided are not the selected values for critical shear stress presented in Appendix F (which are highlighted in blue in Table A20). In addition, when discussing Figure 2-20 in the text, please explain why the critical shear stress is higher at 3.3 cm than 5.5 cm. It would also be beneficial if more of the Sedflume data were presented in a similar manner to Figure 2-20.	The comment is correct. The final critical shear stresses for core SF-10 were 0.4 Pa for both the 3.3 and 5.5 cm intervals. A revised version of the figure is attached (see BCSA Group's original comment response in Attachment A2). The final critical shear stress is higher than the reported values determined from the power law method for both intervals in Figure 2-20. It is important to note, however, that the observations made from the figure are unchanged. As described in response to Comment 24 and in response to other comments, the RI Report will present a detailed and thorough analysis of shear stress in relation to the Sedflume data.	Please refer to Appendix G - Section 3 and Attachment G10.
26	**Page 2-34, Section 2.2.2.3.3, Last paragraph and Page 3-3, Last Sub-bullet (which pertains to Key Finding No. 1):** The Phase 2 Site Characterization Report states that "The observation that the shear stress does not exceed the critical shear stress of the next depth interval tested illustrates that only the low density fluff material at the surface (on the order of millimeters thick) would be mobilized." According to Table A19 in Appendix F, the top tested interval started at 0 cm and ended at 2.35 cm, while the next depth interval tested for this core started at 3.3 cm. Based on the information provided in the appendix, at least the top 2.35 cm of the surface would be mobilized and not just the "fluff material at the surface (on the order of millimeters thick)" as suggested in the text. (In the same context, please refer to Page 2-38 (Section 2.2.3, Second paragraph), resuspension of deeper layers does not need to be a frequent event to result in significant re-exposing/remixing of buried sediment.)	The shear stress is representative of the surface of any interval. While the data are often integrated over the entire tested depth, the measurement has some bias towards the top of that interval. Additionally, because a critical shear stress is exceeded does not mean the entire layer would be quickly eroded away as erosion occurs as a rate over time. The statement made that fluff material at the surface may be mobilized is based on multiple lines of evaluation (e.g., measured sediment properties, TSS values, flux values) which show that small amounts of sediment are subject to resuspension under the vast majority of conditions. The comparison is meant to show that, at a screening level, the observations from the near-bed measurements and Sedflume testing are consistent with other observations of system sediment dynamics. Resuspension and physical mixing potential through the system and across various events will be further evaluated in the RI Report considering all of the factors mentioned in the response to Comment 24.	Please refer to Appendix G - Section 3 and Attachment G10.
27	**Page 2-35, Section 2.2.2.3.4, "Marsh Sediment":** The last sentence in this paragraph states that unlike the results obtained in the waterway sediment layer, the vane shear test data indicate that shear strength on the marsh root sediment layer does increase consistently with depth. According to the Waterway Sediment section above, vane shear test data indicate that shear strength increases with depth in the waterway sediments. Please clarify which statement is correct.	According to the field vane shear test measurement results, the undrained shear strength in waterway sediment samples increases with depth, whereas undrained shear strength data for marsh samples did not show an increasing trend with depth. In the RI Report, the statement will be corrected.	Vane shear data are not presented in the RI, as these data are more relevant to the FS and RD.

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Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
29	**Page 2-49, Section 2.3.2.5, Second bullet from the top:** The Phase 2 Site Characterization Report states that "The analysis shows that for 30 to 50% or more of the monitoring period…" Based on Figure 2-28 the range would be more accurately stated as 20 to 50%. Please review and clarify as necessary. In addition, the text and Figure 2-28 do not state which dissolved oxygen threshold applies to mummichog and which to white perch. Please add this information.	The text appears to be correct as written. For the four stations in southern MBC, BCC, and LBC, DO concentrations fall below the 5 mg/L threshold for white perch at frequencies of 30-40% (MHS-05), 40-50% (MHS-01 Shallow), >50% (MHS-01 Deep), and 40-50% (MHS-02). The footnotes of Figure 2-28 indicate the species applicability of the O thresholds; these will be reflected in RI Report text as needed.	Appendix E - Section 3.2 presents a discussion of DO in BCSA surface water.
30	**Page 2-51, Section 2.3.2.7 Upland Storm Water Runoff:** The information provided in this section refers to primary and secondary COPCs. It is not clear why these contaminants are divided into these designations. This segregation should not be included in the Ecological Risk Assessment.	The BERA will evaluate all chemicals that are detected above screening benchmarks. The designation of primary vs. secondary COPCs was based largely on constituents that were present in multiple media at concentrations above screening benchmarks <u>and</u> elevated compared to reference site levels. The purpose of this designation was to focus the discussion of site characterization data largely on the site-related constituents that would likely represent a large percentage of site-related risks. However, the discussion was not intended to be exclusionary and all compounds that are detected will be considered in the BERA.	As noted in the original comment response, the Group has used and continues to use the primary and secondary COPC designations. The basis for these designations are described in Appendix L - Section 3.
31	**Page 2-54, Section 2.3.3.1, Marsh Well Sampling Results:** Filtered marsh water samples were compared to unfiltered surface water samples. However, for COPCs such as mercury and PCBs that adhere to particulates, filtering the marsh water samples will remove some of the COPCs. The rationale presented is that only the filtered portion is available for interflow, but the suspended material will also discharge out to the surface water (interflow). Further information should be included regarding how this relates to the conclusion that marsh interflow is not a significant source of COPCs to surface water.	Unfiltered data were excluded from this analysis for the marsh well samples. Unfiltered samples have the potential to include particulate matter that is unlikely to be transported a significant distance through marsh subsurface with interflow due to the physical interaction (e.g., filtering) of particulate matter within the marsh subsurface. Therefore, marsh interflow does not represent a significant source of particulate phase COPCs to surface water. This will be explained in detail in the RI Report.	Please refer to Appendix E - Sections 5.1 and 5.3 for a discussion of the marsh interflow and exchange analyses.
32	**Pages 2-58 through 2-66, Section 2.3.4, General Comment:** When drafting future documents, please include a summary of the types of samples obtained for reviewers that may not have lengthy experience with the project. In addition, it may be appropriate to present the findings on the biologically active zone in a separate discussion, as this zone is connected to the ecological analysis of the system.	The next written deliverable will be the RI Report, which will provide the requested summary and consider the suggestions on the presentation of the BAZ.	Please refer to Appendix C - Table 2.
33	**Page 2-59, Section 2.3.4.1, First Paragraph, and Figure 2-37**: As described in the paragraph and shown on this figure, the presentation areas for portions of MBC Ackerman and MBC Walden, as well as MBC South and MBC Walden, overlap. Please make sure that figures depicting these areas indicate clearly which area the samples are assigned to in these overlap areas, and ensure that the data are used in the conclusion for only one of the reaches.	The samples in the overlap areas, which are waterway samples in MBC proper between Ackerman's Marsh and Walden Swamp, were actually used in both presentation areas (PAs). This approach was taken so that in each presentation area, its PA-specific marsh dataset is complemented by a complete waterway dataset that extends across the entire waterway, which is the case in the other PAs. It is recognized that some samples are used twice, i.e., once in each of two PAs. However, the BCSA Group determined that having a complete (full-width) waterway dataset is a greater priority. A footnote will be added along with clarification in the RI Report.	Presentation areas were not used in RI Reporting.

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Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
34	**Page 2-60, Section 2.3.4.2, First Paragraph, First Sentence:** The Phase 2 Site Characterization Report specifies the types of morphological bedforms that were sampled during the Phase 1 and 2 programs, but only specifies the depth of the sample obtained from a single bedform, that is "marshes." Please include the depths sampled from all bedforms to aid in understanding the depth of contamination. Also, please provide a cross-reference to the BAZ sampling and rationale on the selected BAZ thickness.	The cited section, "Sediment Bedform Analysis," is intended to focus on the patterns of surface sediment concentrations among waterway bedforms and the marshes. An exception is the marsh data, which include both the surface (0–5 cm) and near subsurface (10–15 cm) intervals in the analyses. Hence, depths are specified for the marsh data, but not the waterway data, since the latter are limited to the BAZ in the analysis. The 10–15 cm marsh data were included in the analyses since all 0–5 cm sampling locations in the marshes have paired 10–15 cm samples. In the waterways, the BAZ is defined as 0–10 cm in LBC, BCC, and MBC and 0–6 cm in UBC. These depths were established on the basis of an evaluation of SPI data, as discussed in Section 2.3.1 of the Phase 1 Site Characterization Report, p. 2-39 (BCSA Group 2010). Clarification will be added to the RI Report.	Please refer to: RI Report - Section 5.1 Appendix C - Table 2 Appendix F - Sections 3.1 and 3.3.
35	**Page 2-60, Section 2.3.4.2, Sediment Bedform** Analysis: Methylmercury is fairly consistently showing highest concentrations in intertidal samples, followed by subtidal and pool. This trend is true for all segments. This is consistent with the current understanding that mercury methylation is highest in areas subjected to wet/dry periods such as subtidal areas. This should be discussed in the text.	The comment is noted, although it is not clear that this pattern prevails in all study segments. Figure 2-41, which presents methyl mercury results by bedform, indicates that the intertidal concentrations are generally higher than those of subtidal locations in UBC and portions of LBC, but the differences are not evident for MBC and BCC. Statistical population comparisons provide mixed results. While intertidal samples show statistically significant differences (higher concentrations) compared to both subtidal and pool samples in UBC and pool samples elsewhere in the BCSA, the intertidal/subtidal comparisons are more equivocal for MBC, BCC, and LBC. The proposed mechanism explaining higher intertidal concentrations (wet/dry periods) is a potential factor that contributes to differences in methyl mercury concentrations between intertidal and subtidal zones; however, other factors, including, but not limited to, total organic carbon, sulfate, and/or sediment grain size also are likely to play a role. Also, it is assumed that the comment phrase "areas subjected to wet/dry periods such as subtidal areas" should instead conclude as "such as intertidal areas." These processes are discussed further in the responses to Comment 3 and 4, and will be discussed in detail in the RI Report.	The distribution of methyl mercury in sediment is discussed in RI Report - Section 5.1 and Appendix F - Section 3.3. The relationship of methyl mercury to site redox/geochemistry is discussed in: RI Report - Section 6.2 Appendix F - Section 4 Appendix H - Sections 2.3 and 2.4.
36	**Page 2-60, Section 2.3.4.2, Sediment Bedform Analysis:** The conclusion that PCB concentrations are generally higher in waterways and marshes is not clearly demonstrated on Figure 2-41. Additional data analysis should be provided to support this conclusion.	Non-parametric statistical comparisons between waterway BAZ and marsh 0–5 cm samples by PA show that in 8 out of 10 cases, waterway concentrations are statistically significantly higher than those of the corresponding marsh. Comparisons between waterway and marsh 10–15 cm sediment are less conclusive; however, this is to be expected, because marsh concentrations generally increase with depth. The RI Report will include additional data analyses related to this topic. As a clarification, it is assumed that the phrase "generally higher in waterways and marshes" should be "generally higher in waterways than marshes."	Please refer to Appendix F - Section 3.3 and RI Report - Section 5.1. Note that presentation areas are not included in the RI Report.
37	**Page 2-63, Section 2.3.4.4, Second Paragraph/Bullet:** Please indicate that the surface concentrations near Paterson Plank Creek are also elevated based on Figure J-2.	The noted samples are higher than those in some tributaries (e.g., Stiletto Ditch) but also lower than clusters of BAZ points elsewhere in the presentation area (e.g., Eight Day Swamp Tributary, portions of UBC proper). Hence, it is not certain if the requested statement, in combination with existing narrative, is appropriately representative of presentation area conditions. During the preparation of the RI Report, the Group will revisit the extent to which data in small features such as Paterson Plank Creek are described.	The presentation of the nature and extent of COPCs in site sediments is presented in: RI Report - Section 5.1 Appendix F - Section 3.3 Attachments F1 and F6. The RI Report analysis focuses on broader patterns in the spatial distribution of COPCs, consistent with the reach-based approach to remediation anticipated for the site.

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38	**Page 2-64, First Full Paragraph/Bullet:** Please indicate that there are several cores that show elevated concentrations at the surface based on Figure J-4.	While the comment is noted, it is also true that several cores east of Murray Hill Parkway, where higher mercury concentrations are observed, reflect peak concentrations at depth. Future narrative in the RI Report will elaborate on the discussion of the higher mercury concentrations, noting that peak concentrations are observed at the surface in some cores and at depth in other cores.	The presentation of the nature and extent of COPCs in site sediment is presented in: RI Report - Section 5.1 Appendix F - Section 3.3 Attachments F1 and F6.
40	**Page 2-66, Section 2.3.4.5, Bullet List:** Please add a bullet noting that that in several locations in UBS and even MBC, the highest concentrations (and some with similarly high concentrations to the peak interval) occur at the surface.	The comment is noted. During the preparation of the RI Report, the Group will refine the assessment of sediment core concentration patterns with depth.	The presentation of the nature and extent of COPCs in site sediments is presented in: RI Report - Section 5.1 Appendix F - Section 3.3 Attachments F1 and F6.
41	**Page 2-70, Section 2.3.5.3, Third paragraph:** Based on visual interpretation of the referenced figures, it appears that mercury concentrations in mummichogs from MBC and BCC and PCB concentrations in mummichogs from all BCSA reaches were higher in samples collected during the 2011 baseline monitoring program. If this is the case, such results should be referred to in the text.	The RI and Baseline Risk Assessment Reports will include evaluations of spatial and temporal patterns to the data. The implications of these patterns in defining the extent and risk significance of the data will be fully explored in these reports.	Please refer to Appendix I - Section 3 and Attachments I3 and I4.
43	**Page 2-76, Section 2.3.5.7, Biota and Sediment Comparisons:** Linear or logarithmic regressions were used to compare the concentrations of COPCs in different media. A figure should be provided to illustrate the locations of specific samples used and/or excluded in each analysis area. Additionally, other factors such as comparability of the environments that impact boundaries of presentation areas and reaches should be identified.	This type of information will be included in subsequent presentations and analyses.	Please Refer to Appendix I - Section 4.1 and Attachment I6.
44	**Page 2-77, Section 2.3.5.7, Biota and Sediment Comparisons:** Evaluation areas are referenced in the second paragraph of this section. It is unclear if the evaluation areas are different from the presentation areas. This should be addressed.	The term “evaluation area” and “presentation area” refer to the same area designations. Future data presentations will use a single term to identify these areas.	The RI Report does not include either term.
45	**Page 2-78, Section 2.3.5.8, Biota and Surface Water Comparisons**: In the biota and surface water comparisons it is noted that certain data were not included. Exclusion of data from analysis requires more explanation, statistical justification, and detail to understand the impact to the analysis and data bias.	Future data presentations will include an accounting of data used and not used.	Please refer to: Appendix I - Section 4 Attachment I6 Attachment K2.
46	**Page2-78, Section 2.3.5.8, Biota and Surface Water Comparisons**: There were conflicting statements in the text regarding the regression analyses. It may be useful to include a summary matrix indicating what regression analyses were performed to correlate biota to sediment and surface water including filtered, nonfiltered, and DOC and lipid normalization.	Tables 2-6 and 2-7 do provide a summary matrix including this information for both the sediment (MeHg, Hg, PCBs) and surface water (MeHg, Hg) regression evaluations. No regressions were developed for PCBs in fish and surface water because of the low frequency of detection of PCBs in surface water. Future data presentations will include similar summaries of results.	Please refer to Appendix I - Section 4 and Attachment I6.

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47	**Page 2-79, Section 2.3.5.9, Summary of Key Findings - Biota Data Assessment:** It is indicated that spatial trend with larger home ranges (white perch and blue crabs) was less apparent. This conflicts with Section 2.3.5.7 which only included species with small home ranges. Further information should be included to clarify whether any regressions on species such as white perch are limited to whole body tissue samples. Correlations of samples of less than whole body such as fillets or hepatopancreas data cannot address whole body burden or quantify uptake.	COPC concentrations in wider-ranging species (any tissue) did not track with concentrations in sediments and surface water across the BCSA reaches, in contrast to patterns observed in species with smaller home ranges. Because of this, regressions of tissue to media concentrations may be insignificant in more widely ranging species and were not conducted, and instead were focused on those with more limited home ranges. This will be discussed in detail in the RI Report.	Please refer to: RI Report - Sections 5.3 and 6.3 Appendix I - Section 4 Attachment I6.
48	**Page 2-79, Section 2.3.5.9, Summary of Key Findings - Biota Data Assessment**: The conclusions provided should also include considerations of other factors that are known to significantly affect contaminant correlations (e.g., weight, length, and age of fish).	Subsequent reports will include discussion and evaluation of other factors that can affect tissue concentrations.	Please refer to Appendix I - Section 3.2.5.
50	**Page 2-82, Section 2.3.6.2, Last Bullet:** The text discusses an inverse relationship between TSS and organic matter. Since organic matter is linked to oxygen depletion, please include a discussion on dissolved oxygen concentrations. It would be anticipated that UBC with the higher organic matter would have lower dissolved oxygen. (However, data presented in Figure 2-28 suggest that there are lower dissolved oxygen concentrations in the BCC and in LBC.)	The observed inverse relationship between TSS and organic matter appears to be is related to the tidal influx of water from the Hackensack River, which exhibits elevated biological and chemical oxygen demand (BOD, COD) due to ongoing Sewage Treatment Plant (STP) and combined sewer outfall (CSO) discharges to the River. The tidal load of BOD and COD contributes to the reduction in dissolved oxygen concentrations in the BCSA and, in particular, BCC and LBC, which are directly connected to the Hackensack River. The influences of STP and CSO discharges to the Hackensack River are also evidenced by elevated surface water ammonia concentrations in the lower reaches of the BCSA. As shown in Fig. 2-27, ammonia in surface water samples collected in BCC is, on average, 2–3 times higher than that of the samples collected in UBC, which supports the above-mentioned influence of the Hackensack River. This and other factors are discussed in Section 2.3.2.5 of the Phase 2 Report. The RI Report will include an analysis of these and other regional, non-CERCLA stressors on the BCSA.	Please refer to Appendix E - Section 3.2.
52	**Page 2-95, Section 2.3.7.2.1, General Comment:** The discussion of the forms of organic matter is better suited to Section 2.2.2.1 "Sediment Composition." In addition, please add a discussion of the forms of inorganic matter so that the composition of sediments in the Study Area is more fully explained prior to presentation of the results.	The RI Report will include a revised conceptual site model for the physical system and will include a discussion of the forms of inorganic sediment in the BCSA.	Please refer to: Appendix F - Section 3.2 Appendix H - Section 2.3.
53	**Page 2-109, Section 2.4.3.1, Third paragraph, Last sentence:** Please revise to state ". . . Total biomass was generally highest at locations closest to the channel" because the statement does not appear to be true for UBC.	The comment is noted and future discussions of marsh aboveground biomass will note that biomass was highest at the transect location 200 ft from the channel in UBC. This will be discussed in detail in the RI Report.	Please refer to: Appendix L - Section 6 Attachment L10.
55	**Page 2-114, Section 2.4.7 Summary of Ecosystem Data Needs:** It is noted that the fish health will be evaluated by community metrics and condition factors. The evaluation of community metrics may be difficult. There will be a significant amount of uncertainty associated with these data.	Uncertainties will be discussed in the Risk Assessment Report.	Please refer to: Appendix L - Section 6.1.4 Attachment L7.

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56	**Page 2-99, Section 2.3.8 Regional Urban Background Assessment:** The details regarding the selection of sample locations within the individual reference areas should be included. Statistically valid determination of reference area concentrations requires statistically based sampling as opposed to biased sampling.	Reference site sampling was conducted typically in a stratified design, consistent with the BCSA and the types of habitats (e.g., mudflat, subtidal, marsh). The data that were used to evaluate COPC concentrations in the region surrounding the BCSA were compiled from a number of different databases representing monitoring and sampling efforts by a variety of investigators and organizations with varying objectives. Because of the diversity of studies from which the data were derived, statistical hypothesis tests of the similarity or differences in COPC concentrations in the BCSA reference sites and the lower BCSA reaches were not considered appropriate and were not conducted. Instead, tabular and graphical data displays were used to evaluate similarity amongst datasets. The comparisons of BCSA RI data to the regional data was not a statistical test but rather was meant to provide an overall indication of similarity or difference of BCSA RI samples to the regional condition. The Group maintains that the approach used is sufficiently robust to provide meaningful data that can be used to place site COPC data in a regional context. Additional justification for this approach will be provided in the RI Report.	Appendix J presents an analysis of the reference sites and regional background.
59	**Page 2-99, Section 2.3.8 Regional Urban Background Assessment:** RI figures such as Figure 2-40 depict for comparison of site samples to reference areas/regional background maximums appear to include outliers/extremes (in part because the y-axis scale obscures the medians). However, the Appendix S report specifically indicates “Outliers/extremes generally were not used themselves as a point of comparison given that comparing them to individual points is less informative than examining the preponderance of data.” Further information should be provided regarding this change.	The purpose of the regional background evaluation presented in Appendix S was to evaluate comparability of COPC concentrations in BCSA reference sites and lower reaches to regional values. Given that objective, a comparison of extreme and outlier concentrations is less useful and was not done. In Figure 2-40, the purpose was to depict variability of individual sample results over space and time, and in this instance, multiple measures of regional urban background concentrations were used as relative benchmarks. Further discussion of the use of regional background data will be provided in the RI Report.	Appendix J presents an analysis of the reference sites and regional background. The RI Report employs comparison of physical and biological media to the full RI data set (e.g., statistical comparison of medians, box and whisker graphs).
60	**Page 3-2, Major Bullet (associated with Finding No. 1) and Page 3-3, Second Sub-bullet (associated with Finding No. 1):** The major finding bullet states that “The transport of these sediments varies depending on the composition (organic/inorganic) of the particulates.” The minor finding bullet then states that “During major precipitation events, a portion of the upland-derived sediment carried in runoff is transported into the BCSA.” Please include in the list of findings (or clearly state as a known data gap) the estimated amount (or mass) of solids that are transported and the associated contaminant load on these transported solids, particularly the contaminant load on solids that are transported out of the BCSA into the Hackensack River.	As is discussed in the response to Comments 22 and 24, an integrative evaluation of sediment resuspension and accumulation (and associated COPC transport and fate), including analysis of Phase 3 data (including additional data on TSS and contaminants in upland runoff), is ongoing and will be presented in detail in the RI Report.	Appendix D - Section 5 presents an analysis of uplands sediment loads to the BCSA tidal zone. Appendix G - Section 3 presents a comprehensive analysis of sediment transport and deposition in the BCSA based on multiple LOEs.
62	**Page 3-4, Seventh Sub-bullet (associated with Finding No. 1):** The sub-bullet states that “sources of COPCS to the fluff layer likely include some redistribution of COPCs from localized areas of disturbance …” Please include in the list of findings (or clearly state as a known data gap) a description of erosional (i.e., areas of disturbance) zones in the BCSA since not all of the BCSA is net depositional.	As is discussed in the response to Comments 22 and 24, an integrative evaluation of sediment resuspension and accumulation (and associated COPC transport and fate), including analysis of Phase 3 data, is ongoing and will be presented in detail in the RI Report. Importantly, this analysis will include an evaluation of the spatial distribution of potential sediment resuspension and accumulation patterns.	Appendix G - Section 3 presents a comprehensive analysis of sediment transport and deposition in the BCSA based on multiple LOEs.

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Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
63	**Page 3-7, General Comment on "Finding No. 4":** The lines of evidence listed under Finding No. 4 are expected and are indicative of a tidal system, where tidal energy causes resuspension and redistribution of surface sediment. Please include a discussion on these topics. In addition, to better understand fate and transport of these resuspended particles. Please explain how uncertainty of the fate and transport of resuspended material is being reduced for Phase 3.	See response to Comments 22, 24, and 60. In addition, a more detailed and integrated analysis of the site characterization data is ongoing as part of the RI fate and transport analysis. This work is expected to reduce the uncertainty of the fate and transport of resuspended material.	A discussion of particulate resuspension is provided in Appendix E - Sections 4.3 and 5.3. Appendix G - Section 3 presents a comprehensive analysis of sediment transport and deposition in the BCSA based on multiple LOEs.
64	**Page 3-14, General Comment on "Finding No. 10":** Please qualify the statement that "there is no evidence of COPC-related adverse effects on BCSA biological communities" based on the evaluations presented in the Phase 2 report.	The comment is noted. As the comment states, all findings presented in the Phase 2 Report are based upon the evaluations completed as of September 2012 (the date of the report). The RI Report and BERA will provide detailed support for all conclusions related to the potential effects of COPCs on the BCSA biological communities.	Please refer to RI Report - Section 7 and Appendix L.
65	**64. Appendix A Task 6, Page 7:** Since no spiders or amphipods were collected in Bellman's Creek in Phase 2, Phase 3 and/or 3A it may be appropriate to coordinate the sampling to ensure that it is timed with presence of these organisms.	Collection of marsh invertebrates was successfully completed in the BCSA, Bellman's Creek, and Mill Creek in Phase 3A. Limited additional marsh invertebrate sampling was also completed in the BCSA in Phase 3B. These data will be presented in the RI Report.	Marsh invertebrate data are presented in Appendix I - Section 3.1.2.
67	**Appendix B, General Comment:** During the boat run cross-channel transects, it is likely that the boat did not reach the shore or areas where the water was too shallow for the ADCP to make measurements. Please explain how estimates of suspended sediment concentrations were made in these shallow areas, and how this may have affected the water and sediment balances.	Near-bank blanking distance flow rates were determined from Teledyne RD Instruments estimates (trapezoidal method). TSS concentrations were not estimated across-channel. TSS estimates were made only for the location of the moored stations and assumed to be constant across a channel. Further evaluation of these assumptions will be included in the RI Report.	Please refer to Appendix G - Attachment G3.
68	**Appendix B, Page 2-5, Section 2.4.2:** The regression between TSS and turbidity performed using data for all stations showed a moderate relationship. Please explain why these data were pooled together while the ABS data were analyzed for each station. Please address whether there are station-to-station differences in TSS versus Turbidity. The variability and uncertainty from this empirical formulation needs to be quantified and applied in the sediment balance.	TSS was not determined from turbidity. Flux and sediment balance computations utilized ABS to determine turbidity. The other parts of the comment related variability will be addressed in the RI Report.	Please refer to Appendix G - Attachment G3.
69	**Appendix B, Page 2-6, Section 2.4.2:** The regression between TSS and ABS showed moderate relationships. Please quantify the uncertainty and variability in the predicted TSS. This uncertainty should be carried through the sediment balance analysis.	Further evaluation of the calculations, including sensitivity and uncertainty analysis on all input data and incorporating Phase 3 data, will be presented in the RI Report.	Please refer to Appendix G - Attachment G3.
70	**Appendix B, Page 2-8, Section 2.5.1:** If the Rouse equation is used to estimate w_s for the entire water column, please clarify how the bulk settling velocities (w_s) compare to the near-bed estimates.	The settling velocity was not estimated for the entire water column. It was only estimated for near the sediment bed. This will be clarified in the RI Report.	Please refer to Appendix G - Attachment G3.
71	**Appendix B, Page 2-8, Section 2.5.1:** The near-bed settling velocities were estimated in accordance with Fugate and Freidrichs (2002). Maa and Kwon [Estuarine, Coastal and Shelf Science 73 (2007) 351 – 354] indicated some limitation to the approach of Fugate and Freidrichs because of their assumptions and the scatter in their data sets. Please explain whether this affects the calculations in this case.	Maa and Kwon (2007) outline uncertainty that is common to all field measurements of turbulent processes, including those methods applied in the BCSA. These uncertainties propagate into the calculation of settling speeds, but the trends presented in the Phase 2 Report are still robust and valid for the conclusions drawn therein. Further evaluation of the calculations, including sensitivity and uncertainty analysis on all input data and incorporating Phase 3 data, will be presented in the RI Report.	Please refer to Appendix G - Attachment G3.

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Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
72	**Appendix B, Section 3, General Comment:** Please quantify the uncertainty in the flux estimates for water and sediments.	Further evaluation of the calculations, including sensitivity and uncertainty analysis on all input data and incorporating Phase 3 data, will be presented in the RI Report.	Please refer to Appendix G - Attachment G3.
73	**Appendix B, Page 3-1, Section 3.1:** Tidal decomposition was performed by standard fast Fourier transformation. Please provide some details on the methodology, including the variance and residuals from the analysis.	Fast Fourier transformation (FFT) is a standard oceanographic and engineering analysis method. Please refer to Emery and Thomson (1997) Data Analysis Methods in Physical Oceanography for details. FFT analysis was used to low-pass filter flow rate and flux time series, where the filter limit was 35-hours. Tidal decomposition (e.g., harmonic analysis to decompose a sea level time series into sinusoidal components of various tidal frequencies) was not conducted in Appendix B. Filtering of the tidal signal in the flux was done using FFT; however, it is not applicable to produce variance and residuals for a standard filtering operation as it is not a correlation or regression. This will be clarified in the RI Report.	Please refer to Appendix G - Attachment G3.
75	**Appendix F, Page 3, Section 1.2.4:** Please explain the variability introduced by the methodology used to determine the critical shear stress, especially given the fact that data were averaged downcore and spatially as well. Please address how it would change depth average, and inter-site variability if the critical values were strictly limited to the estimated power, which itself is subject to the limitation in the number of points in the regression (Figure 3-1 to 3-3).	In Appendix F, values of critical shear stress are presented by interval. Averages are only presented to examine general trends in particular cores and are not being used in any quantitative analysis. While there is variability among the techniques used for determination of critical shear stress, absolute measurement bounds are used, as discussed in the text, to limit variability in any regression. Variability and uncertainty will be further discussed in the RI Report as the data are applied quantitatively.	Please refer to Appendix G - Sections 2.5.3 and 3, Attachment G9.
76	**Appendix F, Page 5, Section 1.2.6:** The report used an abbreviated version of the erosion rate equation. The report should state that one of the reasons for this abbreviation is because paired bulk density, shear stress, and erosion rates are not directly available to allow for the regression of the complete formulation. This data limitation is because sediment properties are available at discrete depths in the cores that do not correspond to depth where erosion was obtained.	The text states that an abbreviated form is used because, “The variation of erosion rate with density typically cannot be determined for field sediments due to natural variation in other sediment properties (e.g. mineralogy and particle size).” Limitations of the presented analyses will be discussed in the RI Report.	Please refer to Appendix G - Sections 2.5.3 and 3, Attachment G9.
77	**Appendix F, Page 5, Section 1.2.6:** The report states that good fits (i.e., $r^2 > 0.75$) were obtained from the power law regression and used a threshold of 0.75 for acceptance of the correlation analysis. The report needs to provide a caution that the regression is not robust. In many cases there are only 2 or 3 points in the regression and this implies that the correlation coefficient is of little value. In the Tables that show the power law fits, please specify the number of points used in the regression.	The BCSA Group acknowledges the uncertainty in the regression and is limited by the data provided even in the best available erosion measurements. Variability and uncertainty will be further discussed in the RI Report as the data are applied quantitatively.	Please refer to Appendix G - Attachment G3.

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79	**Appendix G, Page 2-5, Section 2.2 and Page 2-7, Section 2.3:** Please provide specific details as to how sedimentation rates for the marsh and waterway core deposition rates were calculated. A sedimentation rate utilizing the surface layer should only be calculated if Beryllium-7 (Be7) is analyzed for and detected in surface sediments. Unless Be7 is detected in the surface layer, or another appropriate tracer is available, there is no way of ascertaining the deposition year of the core top material.	In the RI Report, additional narrative will be provided to explain the calculation methods in greater detail. Briefly, the calculations were performed using the following approaches: Marsh: • ^{137}Cs-1963 rates were calculated as the depth from surface to peak ^{137}Cs activity divided by the years from 1963 to collection year (i.e., 2010). • ^{137}Cs-1954 rates were calculated as the depth from the surface to the “horizon” (i.e., the depth at which ^{137}Cs becomes nondetect), divided by the years from 1954 to collection year (i.e., 2010). If ^{137}Cs was detected throughout the core, then the calculation was performed using the full core depth but qualifying the result as a lower-bound deposition rate. • ^{137}Cs -1954-1963 rates were calculated by dividing the length separating the 137Cs peak and horizon by the 9-year timeframe between the two. Waterways: • The three methods described above for marsh cores were used for waterways. • Additionally, the PCB Horizon method was used. In this approach, the depth from the sediment surface to the point at which PCBs become nondetect was divided by the years from 1927, the assumed earliest possible date of PCB presence, to the collection year (2011). Since the timing of the onset of PCB use in the BCSA is not known, it is stated that the PCB Horizon method provides a lower bound estimate of deposition rates. Refer also to the BCSA Group's original response to Comment 78 (Attachment A2). Concerning the use of the surface layer in sediment rate calculation, the caution concerning the need for ^{7}Be data are understood. The BCSA Group agrees that if ^{7}Be is absent from the surface, then the surface sediments may not represent 2010 or 2011 but may instead represent somewhat older sediment. The lack of ^{7}Be in surface sediment, however, does not preclude the possibility that sediment accumulation has not occurred in the relatively recent past or that deposition is ongoing and will continue into the future. Sediment deposition in estuarine systems is a dynamic process, and the location may have reached a short-term equilibrium and/or been subject to a recent episodic event resulting in localized re-distribution of the very shallow (“fluff” layer) sediment expected to contain ^{7}Be. Hence, if the ^{137}Cs peak is at a depth of 50 cm and the surface layer represents a point in time prior to 2010/2011, the average rate of deposition from 50 cm to the surface would be somewhat higher (due to shorter duration) than would be estimated using the current approach. The estimation of average deposition rate from 1963 to present using this approach is still valid, in that a net deposition of 50 cm from 1963 to present did occur, even if the rates were inconsistent over time.	Appendix F - Attachment F1 presents a detailed analysis of the high resolution cores and geochronological data.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
81	**Attachment G-2, Figures:** Review of the Cs137 profiles for the waterway high resolution cores presented in Figures 1 through 7 of Attachment G-2 indicate that deposition rate using the 1954 and 1963 horizons can only be calculated for a single core, DWC-30, shown on Figure 6. Please include an uncertainty analysis on the calculated sedimentation rates and state the limitations on the Cs137 data usability.	It is assumed that the comment refers to DWC-230 as opposed to DWC-30. It is not certain if the reviewer, in the phrase “deposition rate using the 1954 and 1963 horizons can only be calculated for a single core” refers to the specific 1954-1963 rate estimate or, more generally, to estimates derived from 1954 and/or 1963 horizons (i.e., alone or jointly). Regardless, the BCSA Group generally disagrees with the comment, since all cores with the exception of DWC-211 and DWC-238 convey peak and/or horizon information that can be used to compute deposition rate estimates, even if computed as a bounding value for cases in which a peak or horizon may be present beyond the ultimate core depth. In the RI Report, the requested uncertainty analysis will be discussed. Two general areas that will be discussed for ^{137}Cs uncertainty are the following: (i) typical precision limits, dictated by the narrow (2–4 cm) sampling interval, and (ii) irregular, and more substantial, areas of imprecision arising from uncertain interpretations of peaks or horizons (e.g., when two potential peaks have been identified in a core that are similar in magnitude and are separated by a considerable core depth).	Appendix F - Attachment F1 presents a detailed analysis of the high resolution cores and geochronological data.
82	**Appendix L, Page 2-1, Section 2.1, First paragraph and Table L-1:** The number of perch stomachs examined for reference area fish appears to be 37 adult and 48 juvenile samples rather than 23 adult and 29 juvenile samples indicated in the text. Please explain difference in count.	The counts in Table L-1 (37 adult and 48 juvenile samples) are correct. The text will be updated in the final appendix.	Please refer to Appendix I.
83	**Appendix L, Page 2-2, Section 2.2.1, Second bullet:** “Epifaunal species” rather than “Epibenthic species” is generally used throughout the text, tables, and figures. Please check for consistent use of such terminology throughout Appendix L (e.g., epiphytic/pelagic vs. Pelagic/epiphytic vs. Epiphytic vs. Epipelagic; epibenthic crustaceans).	Consistent terminologies will be incorporated in the final version of this appendix.	Please refer to Appendix L and attachments - throughout.
84	**Appendix L, Page 3-4, Section 3.3.2, General Comment:** Please add a discussion on the overall findings as they relate to the BCSA and reference area food webs. Please include references to the figures developed for stable isotopes.	This discussion will be incorporated in the final version of this appendix.	Please refer to Appendix I - Attachment I5.
85	**Appendix L, Page 3-6, Section 3.4, Third bullet and Appendix L, Page 4-1, Section 4, Fourth bullet:** The conclusion on benthic infauna/algae appears to hold true for the BCSA more than for the reference areas, particularly for benthic macroalgae/detritus. Please provide additional explanatory discussion to support conclusion.	There are patterns in the carbon and sulfur isotopes in producers that help in discriminating energy flow from the base of the food web to consumers. The statement in the text about the lack of importance of benthic macroalgae/detritus is based on the detected sulfur isotope in benthic algae/detritus relative to consumers. Additional consideration of differences between the BCSA and reference sites will addressed in the RI Report.	Please refer to Appendix I - Attachment I5.
86	**Appendix L, Page 3-7, Section 3.4, Second Bullet from top:** The stable isotope data are not so apparent to support this broad conclusion, although the terminology “major differences” does provide a caveat. Please provide additional explanatory discussion to support conclusion.	Additional discussion of the stable isotope data will be provided in the RI Report.	Please refer to Appendix I - Attachment I5.
88	**Appendix M, Page 3-2, Section 3.2, First paragraph:** Based on visual interpretation of the reference figures, it is not so apparent that the taxonomic groups contributing the most to densities did not vary greatly between habitats as indicated. Please provide additional explanatory discussion to support conclusion.	The summary in the final appendix will include a caveat to note there was variability in upper Bellman’s Creek (larger portion of polychaetes in the subtidal versus larger portion of oligochaetes in the intertidal), but that annelids in general dominated all segments across all habitats.	Please refer to Appendix L - Attachment L9.

Table A3. Comments on the Phase 2 Site Characterization Report Deferred to the RI Report

Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
89	**Appendix M, Page 4-1, Section 4.1, General Comment:** Please add discussion of the findings across the BCSA reaches as they relate to the conclusions. Please include a conclusion regarding "... Insight on the potential utility of the benthic community as an assessment receptor in the BERA" as noted in earlier text.	The BCSA Group feels the current discussion of benthic composition across BCSA in the conclusions is adequate as it discusses dominant taxa, similarity across reaches, and comparability to reference – the main focal points of this task. The revised appendix will include a brief summary on the utility of benthic community as an assessment receptor.	Please refer to Appendix L - Attachment L9.
90	**Appendix M, Table M-3:** Not all of the totals appear correct. Please include a footnote stating whether the values were rounded.	Yes, the values were rounded. A footnote will be included in the final appendix.	Please refer to Appendix L - Attachment L9.
92	**Appendix N, General Comment:** The text in Section 1.2 suggests that taxa will be identified to Genus; however, it is noted in Section 2.2 that, where possible, marsh invertebrates were taxonomically identified to Family. Note that taxa are identified to Family in Table N-2. Please make text consistent with actual practice and provide appropriate rationale.	Text in Section 1.2 of the final appendix will note that marsh invertebrates were identified to at least Family, to the extent practicable.	Please refer to RI Report - Section 4.8.2.1.
93	**Appendix N, Page 2-1, Section 2.1, Third paragraph:** It is noted that sticky cards were deployed from September through October; however, earlier text indicates that all sampling was conducted during late July through September.	The third paragraph of the final appendix will have "September through October" changed to "late July through September."	Please refer to RI Report - Section 4.8.2.1.
94	**Appendix R, Page 3-4, Section 3.1.3, Second paragraph:** Please clarify that the Regional Screening Levels are for elemental mercury. Also, please indicate in the text that the average mercury concentrations in all BCSA samples are higher than those in the reference area, if, in fact, this is the case, and that the average mercury concentration at LBC in spring and summer were higher than urban background concentrations. The USEPA's April 2012 Regional Screening Level Table should be referenced.	Regional screening levels are for elemental mercury. The other requested changes will be evaluated in the context of the complete data set and if warranted included in the final version of this appendix to be included in the RI Report.	Please refer to Appendix O - Sections 4 and 5.
95	**Appendix R, Figure R-2:** Please include the USEPA Regional Screening Level on the figure since the figure is referenced in the discussion in the text.	This update will be made in the final version of this appendix.	Please refer to Appendix O - Figure 3.
102	**Page 2-11, Section 2.2.1.3, Table:** Either the conversion of the first value to gallons or the first value itself is incorrect. Please adjust.	The 42 m^3/d value in the table is in error. The correct value is 1,530 m^3/d. The permitted discharge rates will be updated in the RI Report.	Please refer to Appendix G - Attachment G2.
103	**Page 2-14, Section 2.2.1.4, Last paragraph, Last sentence:** The last value should be three times greater than the previous but instead it is an order of magnitude lower.	It is assumed that this comment is referencing the following sentence: "Based on these estimates, evapotranspiration loss from the estimated 3.9 million m^2 of marshes in the BCSA is estimated to average 10,725 m^3/day (2.8×10^6 gal/day) on an annual basis, and could be as high as 39,000 m^3/day (0.31×10^6 gal/day) during the peak summer months." The cited value of 0.31×10^6 gal/day is in error. The correct value is 1.03×10^7 gal/day. The evapotranspiration rates will be updated in the RI Report.	Please refer to Appendix G - Attachment G2.

Notes:

[a]Attachment A2 provides a compendium of Agency comments and BCSA Group Responses. This column presents the previous comment response for context.

Table A4. Comments on the Phase 3a Work Plan and Phase 3 Work Plan/Modeling Addendum Deferred to the RI Report

Document	Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
Phase 3a Work Plan	7	Page 1-2, Paragraph below Imbedded Table: The language regarding the Phase 2 Site Characterization Report should be corrected to present an accurate record. The current language makes it sound like the Phase 2 Report was submitted prior to the Phase 3A Work Plan Addendum, while it actually has not yet been submitted.	Consistent with feedback from the EPA RPM, no revised Phase 3a Work Plan will be submitted. The Phase 2 Report was submitted to EPA by the end of September. A complete timeline that accurately describes what was completed and when during the RI will be included in the RI Report to be submitted after Phase 3B.	Please refer to RI Report - Section 3 and Appendix C.
Phase 3a Work Plan	8	Page 1-3, Bulleted List of Task Summary: Please revise the status of tasks in summary list since Task 3 “Routine Monitoring” and Task 4A “Marsh BAZ Macroinvertebrate Evaluation” were completed in July and August 2012.	Please refer to the response to Comment #7 in relation to document revisions. The task status summary in the Phase 3a Work Plan was accurate as of the document submission date (July 20, 2012), so no revision is necessary. Tasks 3 and 4A were initiated in July and August in accordance with a partial approval from EPA (July 19, 2012). A complete timeline that accurately describes what was completed and when will be included in the RI Report to be submitted after Phase 3B.	Please refer to RI Report - Section 3 and Appendix C.
Phase 3a Work Plan	25	Page 3-13, Sec 3.2.3 Task 2C – Waterway Sediment Pore Water: For mercury and methyl-mercury, the DGTs may provide useful data. However, these tools are still in their early phases of verification, and application by the scientific community. Therefore, another technique should be used to obtain and analyze pore water for mercury (e.g., in situ application of peepers?) Information from the Treatability Study work may alleviate the need for such other analysis. Please clarify the procedure for calculating pore water concentrations from the DGTs.	As indicated in the Work Plan, the porewater sampling approach described for Task 2C was proposed pending the results of validation testing performed for the Treatability Study (TS)/Pilot Study (PS) work, with potential modifications to be proposed based upon the TS/PS findings. Preliminary results for passive mercury sampler testing for the TS have indicated that analytical sensitivity of typical commercially available DGTs for mercury and methyl mercury are not sufficient because low mercury concentrations were encountered in BCSA field porewater. While additional testing is being performed to improve DGT method sensitivity, for the purposes of the Phase 3a RI, the BCSA Group concurs that using the more proven approach of peeper sampling is appropriate for Phase 3a waterway work. A revised scope of work for Task 2C was provided to the EPA in Amendment 1 to the Phase 3a Work Plan Addendum submitted in October 2012. The amendment discussed the use of DGTs, commercial peepers, custom peepers, and centrifuge to evaluate mercury and methyl mercury in porewater. At 11 locations each of these methods will be used to evaluate porewater concentrations and to evaluate which sampling method is best suited for use at the BCSA. The DGT samplers sorb mass from the porewater. The mass that is sorbed is a function of the DGT sampler dimensions, the length of time the DGT was deployed, and diffusion coefficient of mercury or methyl mercury. Upon receiving data describing how much mass is on each DGT sampler, these data are factored into a calculation based on Fick’s 1st Law of Diffusion to estimate the porewater concentration surrounding the sampler.	Appendix F - Attachment F10 presents the analysis of porewater in waterway sediments.

Table A4. Comments on the Phase 3a Work Plan and Phase 3 Work Plan/Modeling Addendum Deferred to the RI Report

Document	Comment No.	Agency Comment	Previous BCSA Group Response[a]	Where Comment is Addressed in the RI Report
Phase 3 Work Plan/ Modeling Plan Addendum	20	Page 4-5, Section 4.2.3.3 (first paragraph) and Figure 2: The x-axis (Figure 2) suggests that the model calibration started on May 29 (not May 19 as stated in the text) and covered approximately 6 days. While the text explanation is understood (that the model was calibrated during a "dry spring event"), it is unclear why a multi-year dataset was calibrated on a 6-day period only. The text in Section 4.2.3.3 infers that other calibration periods were used (in addition long-term calibration is discussed in Section 5.1.3, page 5-4, second paragraph). Please describe the other calibration periods tested and present the results of these calibrations using a coefficient of determination and/or Nash-Sutcliff Index to compare the observed data and simulated data.	The hydrodynamic model calibration included the following primary calibration conditions/periods: 1) dry weather, neap tide (August 29-September 05, 2010); 2) dry weather spring tide (May 29-June 05, 2011); and 3) wet weather rainfall event, spring tide (August 10-16, 2011). These calibration periods were selected based on a review of the 2-year monitoring dataset to encompass the range of prevailing tidal and typical storm conditions in the system. The primary validation period selected for the hydrodynamic model was the period of the dye tracer study (May 10-20, 2011), which includes dry weather neap tide conditions and wet weather spring tide conditions. A full analysis and discussion of the hydrodynamic model calibration will be provided in the Modeling Report, which will be included as an appendix to the RI Report. The presentation will include model predictions across the entire 2-year monitoring period. The example provided in the Modeling Plan Addendum is only for illustrative purposes and a detailed discussion is beyond the scope of the Addendum. There are many methods that can be used to evaluate the model calibration (i.e., the fit of the model-simulated data to the observed data during the calibration period), and all appropriate methods are being considered. The most appropriate methods for the specific datasets of interest in a tidal wetland will be reviewed with the Agency modeling team through collaborative meetings, webinars, and/or teleconferences, and will be presented quantitatively in the modeling report.	Appendix G - Attachment G5 presents the Hydrodynamic Modeling Report.
Phase 3 Work Plan/ Modeling Plan Addendum	21	Page 4-6, Section 4.2.3.4 (first paragraph and Figure 3: The validation results presented in Figure 3 cover short time periods (approximately 7 days) for four tidal cycles. Please explain why these specific time intervals from 2010 and 2011 were selected for validation and presented. For example, do these periods show the best simulated data compared to the rest of the multi-year data? Section 5.1.3 (page 5-4 second paragraph) indicates that both long-term and short-term validation periods will be examined. Please indicate if a one-year validation period was tested; if so, please provide the coefficient of determination and/or Nash-Sutcliff Index to compare the observed data and simulated data.	The primary validation period was selected to encompass a unique period that encompasses a range of site conditions (see above comment response). The model performance with respect to simulating observed conditions was not and should not be considered in the selection of the validation period. As discussed in the above response, the Modeling Report will include a discussion of the model predictions across the full 2-year monitoring period.	Appendix G - Attachment G5 presents the Hydrodynamic Modeling Report.
Phase 3b Work Plan/QAPP Addendum	11	Work Plan, Section 2.3.1.1 "Task 10," Page 2-5 and Figure 2-3: As discussed during the March 2013 meeting, it may be more appropriate to revise the Thiessen Polygons to respect the internal waterways on the marshes. As currently, presented the polygons abruptly cross over marsh tributaries because ArcGIS is following a program to find the mid-point between sampling locations. It may be beneficial to use professional judgment on the polygons and adjust where needed to respect natural features in the marshes.	Comment noted. Future analyses using Thiessen Polygons will not be extrapolated across major marsh tributaries.	Thiessen Polygons were not used in the RI.

Notes:

[a] Attachment A2 provides a compendium of Agency comments and BCSA Group Responses. This column presents the previous comment response for context.

Final
Attachment A2: Compilation of BCSA Group Responses to EPA Comments on Past RI Deliverables

EPA Comment Response Summary

Berry's Creek Study Area
Remedial Investigation

Submitted to

U.S. Environmental Protection Agency

Submitted by

Berry's Creek Study Area Cooperating PRP Group

September 2017

Berry's Creek Study Area
Phase 1 Site Characterization Report – Responses to Agency Comments

General Comments

1. The Phase 1 Site Characterization Report presents many findings. All findings in the Phase 1 are considered tentative, even upon EPA approval, as the Phase 1 Report will be superseded by the subsequent Phase 2 Report and overall Remedial Investigation Report. As such, EPA is not commenting on every conclusion that it may have a potential issue with. However, it should be noted that it is apparent that, in the few conclusions that are made, the report seems to hint that the system is recovering naturally. Such conclusions are still premature.

Response: The Group recognizes that data analysis and interpretation will continue throughout all three phases of the Remedial Investigation (RI). Conclusions regarding contaminant transport and fate, including implications for natural recovery processes, will be revisited as more data become available and lines of evidence are evaluated.

2. There is an awkward avoidance of any specific company name in the reports. Even names of the Superfund sites are omitted. At the same time the NJSEA, Teterboro Airport, and landfills are specified. EPA has given deference to the BCSA Group in allowing the reports to omit the names of facilities that have contributed contaminants to the system, but the current approach seems hypocritical.

Response: The Group has compiled available data regarding potential current and historic discharges to the BCSA (Figures 1A through 1D). The figures are provided for reference throughout the Remedial Investigation/Feasibility Study (RI/FS) and will be updated periodically. They identify several types of sites, using both publically-available datasets, as well as information developed during the Phase 1 investigation. Mapped locations include Group member sites as well as other facilities. The following types of sites are depicted on the figures: Superfund sites, NJDEP Known Contaminated Sites, sites with NJ Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water permits, unpermitted outfalls observed during Phase 1, historical landfills and dumps, and historical sewage treatment plants.

3. TSS/Turbidity Correlations - A major objective in Phase 2 appears to be to quantify solids loading to the system. Of particular importance is the understanding of the net influx of solids that enter the system from the Hackensack River. Multiple studies are proposed to develop a relationship between turbidity measurements and total suspended solids measurements. However, EPA has seen few examples where such relationships have been developed successfully. Given the importance of this information, EPA believes that the BCSA Group should conduct sufficient direct measurements of TSS to support the solids calculations required for the project. Additional efforts to develop TSS/Turbidity correlations may be attempted, but they should not be the primary approach to obtain the necessary information.

Although we have another phase of field work remaining, part of the reason that the SOW had three years of data collection was the intention to monitor water-column data over several years. The current plan, if unsuccessful, may not collect sufficient water-column solids information in the three years of field work.

Response: The BCSA Group has added more direct measurements of TSS to its Phase 2 hydrodynamics sampling program, as described in Section 3.1 of the revised Phase 2 Work Plan Addendum (Geosyntec, April 2011). TSS measurements will also be collected from a subset of the manual surface water samples (Section 3.2.1 of the revised Phase 2 Work Plan Addendum; Geosyntec, April 2011). These data, in combination with other lines of evidence from Phase 1 and Phase 2 (e.g., LISST data), will provide sufficient data to characterize the suspended sediment pool. Additional direct measurements of TSS may also be collected in Phase 3 of the RI, as necessary to fill data gaps to adequately characterize sediment flux in the BCSA.

4. The agencies (EPA, NJDEP, NOAA and F&WS) have had lengthy discussions regarding the proposed reference areas. The problem seems to be that there are no appropriate reference areas in the Meadowlands for all purposes. EPA recommends selecting two different types of reference locations; specifically one for risk assessment purposes and one for risk management purposes. The risk assessment background location will be used to derive clean-up goals, while the risk management background locations will be used to fine-tune the clean-up goals to derive preliminary remedial goals which reflect the urbanization of the Site. To calculate risk assessment derived clean-up goals, EPA recommends the use of the Mullica River. The portions of the Mullica River selected should have similar salinities to the portion of Berry's Creek that it is being compared to. Sediment and surface water data should be collected from this area. Several risk management reference locations, as proposed should be continued to be investigated. These should be located within the Hackensack watershed and reflect the urbanization of the area (e.g. nutrient loading, wastewater treatment plant discharge, etc.). From these areas sediment, surface water and biota (crabs, mummichog, mammals, plants, insects) samples should be collected. EPA believes that this approach is a realistic compromise given the levels of contamination in many of the areas previously discussed as potential reference areas.

Response: The BCSA Group recognizes that reference areas have a role to play in both the risk assessment and risk management components of the RI/FS. However, the BCSA Group does not understand the value of comparing the BCSA to a pristine reference area if remedial goals will be established in the context of an urban setting. With respect to risk assessment, cleanup goals will be derived from site-specific risk characterization and modified based on an understanding of reference area and background conditions. Further discussion of the reference areas, risk assessment, and risk management process will be included on the agenda for an upcoming meeting with the USEPA.

With respect to the recommendation that the Group use the Mullica River as a reference location, a detailed site-specific evaluation of the Mullica River as a potential reference area for the BCSA was provided in Appendix P of the Phase 1 Site Characterization report. The evaluation used multiple criteria, consistent with relevant USEPA guidance and scientific literature. Based on this analysis, the Mullica River does not meet the requirements set forth under CERCLA, i.e., that a suitable reference site exhibits the ecological conditions that would be attainable at the site but for the release of the hazardous substance (CERCLA, 43 CFR 11.14). Unlike the Mullica River watershed, the BCSA and the Meadowlands in general have been subject to a century of non-point source pollution from urban runoff, placement of fill in the wetlands, and extensive hydrologic modifications (e.g., extensive ditching and diking to eradicate mosquitos) that are not related to CERCLA releases. In conclusion, the significant differences between BCSA and Mullica River in terms of physical, chemical, and biological characteristics make the Mullica River an unsuitable reference site for the BCSA. To further understand the influence of regional background conditions on the BCSA and the three urban reference areas, sampling of the surface water, sediment and biota was substantially increased in Phase 2. In addition, a regional background data review task has been added to the scope of work (Task 8, Section 3.8 of the Phase 2 Work Plan Addendum).

These two sources of urban background and reference area data along with the extensive data from the four BCSA study segments will provide a strong basis for understanding what the site conditions would be but for the release of hazardous substances within the BCSA.

5. The process of screening Contaminants of Potential Concern (COPCs) in the Phase 1 effort compared data from the BCSA site to reference sites, which eliminated several COPCs. Such a process may greatly reduce the number of samples analyzed for certain COPCs, thereby limiting the ability to evaluate the risk from these compounds. While the selection of COPCs seems to be appropriate overall, the BCSA Group should ensure that data is collected, in the correct media, to evaluate risks for COPCs that exceed screening criteria. Therefore, it is also important that the full parameter subset is sufficient to support all necessary risk assessment evaluations.

Response: All of the Phase 1 surface water and sediment samples were analyzed for the full parameter list. The locations of Phase 2 samples for the full parameter list were selected primarily to support the risk assessments (e.g., exposure point concentrations). In addition, some of the samples are targeted to potential continuing source areas and a few will be collected from deeper marsh sample intervals. Figures that designate locations where the surface water and sediment samples were collected for the full parameter list will be included in the Phase 2 report, as well as a table showing the percentage of sample locations that were analyzed for the full parameter list following the completion of Phase 2 work, similar to what was provided to the agency with the response to Phase 2 Work Plan Addendum comments (July 27, 2010).

6. Given that PCBs are considered a COPC at the site it may be appropriate to include *congener-specific PCB analysis during future phases of work. In any case, the DQO process should be clearly documented to ensure that the PCB data collected will meet appropriate quantification limits. In addition, congeners are preferable for evaluation of uptake by biota from sediment, water and/or food chain. Congener data may also be useful for determining sources of PCBs. Congener data is also necessary to quantify risk using a TEQ approach.*

Response: As noted in USEPA's Contaminated Sediment Guidance, the need for PCB congener analysis should be based on site-specific considerations. The Group finds that the site-specific data needs to support risk management decisions in the BCSA can be met with Aroclor analysis. The rationale for this determination is provided in the Revised Phase 2 Work Plan Addendum and Quality Assurance Project Plan Appendix E – DQO Table 8 (Geosyntec, April 2011). However, the BCSA Group has agreed to evaluate the congener data from the UOP Site as part of Phase 2 work and to evaluate, in consultation with the USEPA, what additional congener data/analysis is needed in Phase 3 to complete answers to relevant technical questions, as well as USEPA administrative requirements for PCB sediment sites. Please also refer to the response to Comment #16.

7. The Conceptual Site Model does not adequately discuss the importance of resuspension due to tidal energy. More information on the non-compacted surface "fluff" layer should be incorporated into the CSM.

Response: Resuspension mechanisms are recognized as an important component of the conceptual site models (CSMs) (Figures 3-27 to 3-31 in the Phase 1 Report, February 2010). Additional information regarding resuspension in the BCSA, including the importance of the fluff layer, was included in the Group's presentation to USEPA during the work session on August 4, 2010 (slide numbers 14-17, available on the BCSA USEPA Deliverables Website). The Group is proposing to take several steps to evaluate the deposition, accretion, resuspension, and erosion dynamics throughout the BCSA in more detail going forward (see Section 3.1 of the Phase 2 Work Plan Addendum; Geosyntec, April 2011). Ensuring that sufficient data are collected to thoroughly evaluate the relative importance of these mechanisms was a focus of the Phase 2 Work Plan revisions. The Phase 2 Report will present updated CSMs that reflect the Group's understanding of resuspension and sediment transport mechanisms in the BCSA based on analysis of Phase 1 and Phase 2 data.

8. The sediment core category called "no net change" might more accurately be referred to as "net-erosional" (It might help to specify the timeframe which the category applies to.) Cores collected at sampling locations 115 (LBC), 127 (BCC), 128 (BCC), 141 (MBC), and 159 (MBC) are examples of net-erosional areas in Berry's Creek. These cores report non-detected concentrations of cesium-137 (Cs-137) throughout the core, dating the sediments throughout the core as pre-1950. Because of the nature of Cs-137, the data show that these sampling locations have been impacted by erosion (e.g., the post-1950 sediments have been removed). Moreover, these locations continue to experience erosion due to the lack of net-deposition of *cesium-bearing solids and little to no beryllium-7 (Be-7) bearing material.*

Response: The term "net erosion" implies that the elevation of the mudline (sediment-water interface) is systematically dropping over time, i.e., the waterway is deepening over time. There is no evidence that this systematic deepening has occurred in the BCSA. While an absence of ^{137}Cs detections in the sediment profile indicates the possibility that no deposition has occurred since 1954 or earlier at some locations (see also the response to Comment #234), it does not provide any evidence of "net erosion." It is possible, and moreover likely, that balancing cycles of periodic deposition and resuspension occur in these areas. ^{7}Be was detected in surface sediments in two of the five cores referenced above, providing evidence of recent sediment deposition at some of these locations. Multiple lines of evidence independent of geochronology data also suggest that that predominant net change occurring in the BCSA is depositional. These additional lines of evidence include both qualitative and quantitative factors such as:

- the BCSA is a shallow fringing marsh estuary environment that is defined by relatively low energy and net depositional processes during periods of sea level rise (e.g., Friedrichs and Perry, 2001; Reed, 2002),
- near isolation of LBC from most freshwater flow by the construction of BCC approximately a century ago,
- reduction of system tidal prism and resultant tidal flux reduction brought about by development-driven marsh encroachment in the last several decades, and
- systematic reduction of freshwater and anthropogenic sediment inputs brought about by the diversion of publicly owned treatment works (POTW) discharges from the BCSA to the Hackensack River at Little Ferry.

All of these mechanisms and the nature of the system result in a reduction of system energies compared with upland streams or the main stem of the Hackensack River, which supports an increasingly favorable environment for net deposition. These factors have been discussed in detail in several project documents, including Scoping Activities documents, the Phase 1 Work Plan (Geosyntec/Integral, 2009), the Phase 1 Report (Geosyntec/Integral, 2010), and the August 4, 2010 presentation to the USEPA.

Please also refer to the responses to Comment #s 9, 231, and 234 regarding ^{137}Cs data interpretation, and the response to Comment #10 regarding ^{7}Be data interpretation.

9. EPA's oversight contractor evaluated the low resolution cores using the following geochemistry criteria for radionuclide dating of sediment cores:

(1) a clear Cs-137 peak with peak concentration greater than 0.5 picocuries per gram (pCi/g),

(2) non-detected Cs-137 concentrations are <u>only</u> measured at depth intervals that are below the 1954 time horizon, and

(3) same grain size exists throughout the core.

The evaluation of the 27 low resolution cores that were collected in Phase 1 found only 3 cores that would be considered datable by the above criteria. The 3 datable cores include; 168 (UBC) with a 0.54 cm/yr rate; 178 (UBC) with a 0.98 cm/yr rate, and 186 (UBC mudflat) with a 0.33 cm/yr rate. Rates presented here were calculated as part of the analysis and are lower than the "preferred" sedimentation rates stated in Table O-1 in Appendix O. This information suggests that the report may overemphasize sedimentation rates with the BCSA.

Response: It is important to recognize that the idealized conditions listed above often do not hold completely true in complex environmental settings such as the BCSA. Although radionuclide data from the Phase 1 low resolution cores do not consistently meet the requirements of an idealized profile outlined above, the Group determined that the data nevertheless provide useful information regarding deposition in the BCSA with appropriate consideration of sources of uncertainty during data interpretation. The geochronology data were therefore evaluated in conjunction with other lines of evidence (e.g., bathymetric, geophysical, and grain size data) when identifying appropriate locations for more detailed high resolution sediment cores in Phase 2. The Group will consider the agency comments regarding radionuclide data interpretation during the evaluation of Phase 2 high resolution cores. Please also refer to responses to Comments #231 and #234 regarding ^{137}Cs data interpretation.

10. A surface sediment concentration map for Be-7 bearing sampling locations only should be included. In order to evaluate recent deposition utilizing Be-7, a separate program to re-occupy the Be-7 bearing sampling locations from Phase 1 with the collection of a 0-2 cm sediment sample and analysis for Be-7, PCB (congeners?), mercury, and methylmercury should be considered. Such a program would provide better information with respect to the resuspension and transport in the system.

Response: Results of the ^{7}Be samples proposed as part of the Phase 2 high-resolution coring program will be considered in combination with the Phase 1 ^{7}Be results, and the value of a plan-view analysis of the complete ^{7}Be dataset will be considered at the completion of Phase 2. Shallow sediment samples (0 to 2.5 cm) have been collected for COPC analysis in 40 locations as part of the Phase 2 investigation, and those results will be considered in the context of other data relating to sediment dynamics in the BCSA. Evaluation of sediment resuspension and transport are a primary focus of the Phase 2 sampling program, as described in the response to Comment #7.

11. The lack of surface sediment samples in Phase 2 in the Hackensack River will likely limit the understanding of the transport of contaminants into and out of the Hackensack.

Response: The combination of the following sources of information will provide sufficient information to support decision-making related to the BCSA, while recognizing its interaction with the Hackensack River.

- Gradients of COPC concentrations in the BCSA up to the confluence with the Hackensack River;
- Comparisons of BCSA COPC concentrations with reference areas upstream on the Hackensack River;
- Measurements of suspended particulates coming into and out of the BCSA near the confluence; and,
- Regional background data review to understand the historic and recent COPC distribution in the Hackensack River estuary.

12. The lack of sediment cores in the Hackensack River in Phase 2 will limit the understanding of historic transport of contaminants from Berry's Creek.

Response: Understanding historic transport from the BCSA is not a study question. There would be large uncertainty associated with any Hackensack River data due to numerous sources directly to the river that would require a substantial effort to secure reliable data and is not necessary to select a remedy for the BCSA. In addition, the Hackensack River is a substantially different sediment system and meaningful sampling would not improve decision-making for the BCSA going forward.

13. The Phase 2 water-column monitoring program should include Laser In-Situ Scatter and Transmissometry (LISST), Acoustic Doppler Conductivity Probe (ADCP), and Optical Back Scatter (OBS) equipment at all five mooring locations.

Response: As described Section 3.1 of the revised Phase 2 Work Plan (Geosyntec, April 2011), the proposed sampling program includes flow velocity measurements using either ADCP (Note: ADCP is an Acoustic Doppler Current Profiler) or an Acoustic Doppler Velocimeter (ADV), as well as OBS measurements, at all five moored locations; these measurements were also collected at all five locations during Phase 1. ADCP is used for flow measurement at four of the five moored locations; an ADV is installed at station MHS-07 in Upper Berry's Creek (UBC) where low tide water depths are too shallow to permit use of an ADCP. The YSI water quality meter that is installed at all moored stations collects turbidity readings using an OBS sensor.

Long term installation of LISST instruments at all five moored stations for the duration of the Phase 2 program is not feasible for two reasons. First, the LISST sensors typically foul quickly, thereby requiring a significant level of instrument maintenance to obtain quality continuous data. Second, these instruments are very expensive, and the cost to install five instruments for long deployments is not cost-effective. Long term deployment of LISST instrumentation is proposed at two of the moored stations (MHS-01 in BCC and MHS-06 in UBC) to characterize particle size distributions over multiple tidal cycles (Section 3.1.1 of the Phase 2 Work Plan). In addition, LISST measurements are proposed at numerous locations during both of the transecting events in Phase 2 (Section 3.1.2.1 of the Phase 2

Work Plan). These data, in combination with the significant LISST dataset from Phase 1 and other lines of evidence from Phase 1 and Phase 2 (e.g., TSS and turbidity measurements), will provide sufficient data to characterize suspended sediments in the BCSA.

14. Future reports should be cautious of using arithmetic averages for analyzing sediment concentrations for a non-random sampling design. Consideration should be given in Phase 3 toward how surface sediments concentrations will be averaged. Proper statistical design should be incorporated based on how the data will be analyzed.

Response: The Group chooses the systematic stratified method of analysis because statistical methods are difficult to apply to large area with gradients of independent environmental variables. It relies on visual displays of data to establish patterns in the data. The strength of the analysis is built on multiple lines of evidence, understanding of processes that control COPC movement/deposition, and iterative addition of data to determine if more data is supportive or contrary to initially observed patterns. Phase 1 Biologically Active Zone (BAZ) sediment sample locations were selected to equally sample the various types of sediment environments present in the BCSA (i.e., differing tidal status, study segments, etc.) as described in the Phase 1 Work Plan (Geosyntec, 2009). Phase 1 sediment core locations were selected to evaluate the influence of depositional environment (i.e., subtidal areas, intertidal mudflats, pools) on COPC distribution. Phase 2 sediment sample locations (both BAZ and cores) were identified to fill data gaps recognized during the analysis of Phase 1 data. Also, refer to the response to Comment #95 for additional discussion of area-weighted averaging.

15. A hydrodynamic model should be developed for Berry's Creek. Most of the data collections to support such a model are being conducted already, and the regional hydrodynamic model for the Newark Bay and surrounding waters would help provide boundary information.

Response: The hydrodynamics of the BCSA are being evaluated in detail through collection of extensive data during a full range of flow and tide conditions over a three year period. The BCSA Modeling Plan calls for a careful review of the additional modeling needs following Phase 2. Modeling tools that are the best match for the BCSA physical, chemical and biological templates and site-specific study questions will be incorporated into the Phase 3 work scope. Application of the regional model, which was designed primarily for large scale total maximum daily load (TMDL) analysis of major waterways, is not well suited to the finer scale transport process assessment that is required in the shallow waterway and extensive fringing marsh system of the BCSA. The BCSA Group has begun exploration of potential hydrodynamic modeling of the BCSA and is exchanging information with the UOP modeling team, which is evaluating the Ackerman's Creek area.

16. Further discussions are warranted between the agencies and the BCSA Group on whether dioxin should remain a COPC, and if so, how that risk calculation would be made.

Response: As a result of recent discussions with the agencies, the Group has agreed to evaluate the dioxin-like PCB congeners from the UOP congener data and will likely collect additional PCB congener data is Phase 3. This is consistent with the findings that PCB contamination is site-related. Since dioxin is not site- related, the Group has proposed to take into account regional risk assessment of dioxins by NJDEP related to the regional fish and crab advisory. The BCSA Group will discuss this topic further with USEPA.

Specific Comments

Executive Summary

17. Executive Summary, Page ES-7: Second bullet is not a finding and should be removed.

Response: As presented in the Group's response to comments regarding the Phase 2 Work Plan (July 27, 2010), the Phase 1 report comments will be addressed in this response to comments, as well as some supplemental materials. However, the Phase 1 report will not be revised and reissued. The Phase 1 comments and responses will be further addressed in future deliverables including the Phase 2 Report, Pathway Analysis Report, Baseline Ecological Risk Assessment, and the Modeling Plan.

18. Executive Summary, Page ES-6, Task 2: The 5th bulleted item under 'Task 2' is missing the parentheses or is incomplete.

Response: Comment noted; please refer to the response to Comment #17 above regarding Phase 1 report revisions.

19. Page ES-6, 3rd bullet from bottom – Surface water standards require comparison to unfiltered samples.

Response: Subsequent evaluations of surface water data will consider dissolved and total concentrations, as appropriate, depending upon the constituent and exposure route being evaluated. Please also refer to the response to Comment #69 regarding selection of surface water screening criteria.

20. Page ES-7, 2nd bullet from bottom – Please delete. It is premature to have findings whether natural recovery is occurring. Net deposition does not automatically equate to natural recovery.

Response: Conclusions regarding contaminant transport and fate, including implications for natural recovery processes, will be revisited as more data become available. Please refer to the response to Comment #17 regarding Phase 1 report revisions.

21. Page ES-12, 3rd and 4th bullets – Please note, EPA believes it is inappropriate to utilize the camera data for adjusting consumption assumptions, although it may be discussed in the uncertainty analysis.

Response: The camera surveys of human use will be continued at several locations. The objective is to ensure a robust data set, as well as data from additional seasons to reduce uncertainty in assumptions regarding the frequency and duration of human activity.

Section 1

22. Section 1.2.2, Page 1-4: The 3rd bullet under 'Ecological System' states that marsh vegetation reduces the bioavailability of contaminants of potential concern (COPCs); however, the marsh areas also provide conditions favorable to generation of methyl mercury. Given that Phase 2 is attempting to resolve some of these issues, it is premature to make such a conclusion.

Response: The significance of marsh vegetation and sediments for COPC fate, transport, and bioavailability will continue to be evaluated during the Phase 2 RI (e.g., *Phragmites* tissue sampling, marsh sediment methylation/demethylation cores). Please refer to the response to Comment #17 above regarding Phase 1 report revisions.

23. Section 1.2.3, Page 1-6: The second paragraph under 'Study Question 2' states that the creek bed and marsh sediments have been "influenced by historic loading from all of these sources since the early to mid-1990s." Assuming this is a typographical error and should be "mid-1900's," it still would be clearer to state this less ambiguously (i.e., mid-1900s could mean either the decade or the century).

Response: This was a typographical error and the sentence should read "The creek bed and marsh sediments have been substantially influenced by historic loading from all of these sources since the early to mid-1900s." Based on review of available documentation regarding current and historic industrial and sewage discharges to Berry's Creek, COPC loading to the BCSA from these sources is estimated to have started prior to 1930, and continued through approximately the mid-1970's (NJDOH, 1930; Geosyntec, 2009 and references therein). Please refer to the response to Comment #17 above regarding Phase 1 report revisions.

24. Section 1.2.3, Page 1-7: The first paragraph under 'Study Question 4' should be expanded to identify routine tidal energies as a source of sediment resuspension and transport, in addition to storm events.

Response: Diurnal tides are recognized as a factor influencing sediment resuspension and transport in the BCSA, as presented by the Group during the August 4, 2010 work session with USEPA (see slides 20, 22, 54). Please refer to the response to Comment #7 for additional information regarding assessment of sediment dynamics during Phase 2, and the response to Comment #17 regarding Phase 1 report revisions.

25. Section 1.2.3, Page 1-7: The third paragraph under 'Study Question 4' states that multiple lines of evidence indicate the Study Area is net depositional and stable. The lines of evidence should be summarized in a series of bullet items. Key empirical methods to evaluate sediment and contaminant movement are summarized in Highlight 2-10 of USEPA's Contaminated Sediment Remediation Guidance. Additional lines of evidence need to be gathered to conclude that the majority of sediments in the Study Area are stable, including time-series observations of surface sediment concentrations, comparison of concentration patterns during and after high energy events, in-situ or ex-situ erosion measurement studies (e.g., Sedflume), and further characterization of the Study Area sediment balance.

Response: The lines of evidence supporting net deposition and sediment stability will be summarized in a series of bullet items in the Phase 2 Report. Regarding additional lines of evidence, direct measurement of sediment erosion rates via Sedflume during Phase 2 will provide a quantitative measurement of sediment stability that can be used to determine the potential for sediment mobility in the BCSA (Section 3.1.7, Phase 2 Work Plan; Geosyntec, April 2011). The findings from the sedflume study, as well as other lines of evidence from Phase 1 and Phase 2, will be presented in the Phase 2 report to evaluate the role of diurnal and storm tides in sediment resuspension and transport in the BCSA. Please refer to the response to Comment #7 for additional information regarding assessment of sediment dynamics during Phase 2, the responses to Comment #17 regarding Phase 1 report revisions, and Comment #24 regarding evaluation of sediment transport and stability in the BCSA. Refinement of the sediment balance is a primary focus of the Phase 2 scope of work.

26. Section 1.2.3, page 1-9, Study Question 7, middle of 2nd paragraph – the text says "low" salinity range. Shouldn't that be "high," given that it is in reference to the diversion of freshwater from the Hackensack.

Response: The use of the term "low" is unclear as noted by the reviewer. The BCSA experiences a wide range of salinity depending on conditions (e.g., tide cycle, storms, etc.), particularly near the confluence with the Hackensack River (LBC range: 2.69 to 13.8 ppt, BCC range: 0.96 to 12.72 ppt), but the salinity is low compared to sea water. Prior to the diversion of freshwater from the Hackensack River basin, the surface water in the BCSA was typically freshwater.

27. Section 1.2.3, Page 1-11, Second Bullet: Correct "date" in second sentence to "data."

Response: Please refer to the response to Comment #17 regarding Phase 1 report revisions.

28. Section 1.3.1, Page 1-16: Known historic sources of contamination, including Superfund sites and sources of significant industrial discharges, should be identified (similar to the Sewage Treatment Plants).

Response: Please refer to the response to General Comment #2 regarding current and historic sources and discharges in the BCSA.

29. Page 1-22, second paragraph: Please add RAGS F (2009) to the list of EPA guidance documents.

Response: RAGS F (2009) will be listed as a reference in future documents regarding the Human Health Risk Assessment (HHRA). Please refer to the response to Comment #17 regarding Phase 1 report revisions.

30. Figures 1-4 a, b, c: The deep 15-30 cm transect cores are not depicted in the figures. A figure should be provided that includes the results of deeper sediment core slices.

Response: The series of Figures 1-4a through d used a global legend that depicted all symbols used in the series, but deep transect cores were only collected in UBC (Figure 1-4d) during Phase 1. The legend will be corrected on the relevant Phase 2 Report figures.

Section 2

31. Section 2.1.1, Page 2-1: Please clarify the second bullet, which states that the thalweg is at a higher elevation in Lower Berry's Creek, and therefore Lower Berry's Creek has a lower energy environment. Isn't the lower energy environment in Lower Berry's Creek more a function of the construction of Berry's Creek Canal? It is conceivable that a higher thalweg would cause higher velocities during ebb and flood tides.

Response: The higher thalweg elevation in Lower Berry's Creek (LBC) in relation to Berry's Creek Canal (BCC) or Middle Berry's Creek (MBC) is one line of evidence for the existence of a primarily depositional environment in LBC. As noted in the comment above, the lower flows are the result of water diversion into BCC approximately 100 years ago. Prior to construction of BCC, the channel elevations in lower MBC and upper LBC would have been similar, as predicted based on hydrology and geomorphology principles. When water was diverted to BCC, the decreased flows in LBC would have resulted in a lower energy environment which is more favorable to sediment deposition, thereby raising the elevation of the channel bottom, including the thalweg. This prediction is consistent with the Phase 1 geochronology data, which indicated that some of the highest measured deposition rates occur in LBC (Phase 1 report, Appendix O). Factors influencing sediment transport and deposition are a primary focus of Phase 2, as discussed in the response to Comment #7. Please also refer to the response to Comment #17 regarding Phase 1 report revisions, and the response to Comment #33 regarding the LBC water budget.

32. Section 2.1.1, Page 2-1: Third bullet regarding Berry's Creek Canal should be expanded to discuss depositional characteristics as was done for Lower Berry's Creek. It seems that Berry's Creek Canal would have received deposition since its construction due to its deeper channel. The construction of Berry's Creek Canal should be discussed relative to the history of contaminant discharge; it is likely that the entire sediment column above the design depth of the channel is contaminated.

Response: As discussed in the response to Comment #23, industrial and sewage discharges to the BCSA are estimated to have initiated prior to 1930, and to have continued through the probable peak in the 1960s. BCC was constructed in 1911 through 1912 (USWO, 1911; ERC, 1912) to facilitate navigation of Berry's Creek and improve operation of the rail line that remains today. The results of geophysical investigations (bathymetric survey, seismic and sub-bottom profiling) completed as scoping activities indicate that BCC was cut into the Pleistocene clay deposit (Earthworks, 2008); the sediment overlying the Pleistocene clay was therefore deposited between 1912 and the present. Additional evaluation of sediment deposition and the relationship to COPC distribution throughout the BCSA will continue in Phase 2. Please refer to the response to Comment #17 regarding Phase 1 report revisions.

33. Section 2.1.1, Page 2-3: Summarize the water budget analysis for Lower Berry's Creek. This segment was omitted in this section of the report.

Response: The referenced section was intended to provide a brief summary of the key findings of the water budget analysis and to emphasize updates from the preliminary water budget analysis presented with the Phase 1 Work Plan. Important considerations from the water budget analysis for LBC are summarized below.

Due to its direct connection with the Lower Hackensack River and limited upland runoff inputs, LBC is more efficiently flushed by tidal action than the upper reaches of the BCSA. Historically, LBC supported substantially greater tidal energy; however, construction of BCC and the resulting reduced connection of LBC with the rest of the BCSA waterways resulted in a substantive reduction in the tidal prism conveyed through LBC. The degree of connectivity between LBC and BCC and MBC was not fully understood at the time the Phase 1 report was submitted. Additional hydrologic data was collected subsequent to submission of the Phase 1 report, and data collection will continue throughout Phase 2. The water budget for LBC will be revisited in the Phase 2 report.

34. p. 2-4, Section 2.1.2.2: The report states, "The pilings at stations MHS-02, MHS-03, MHS-04, MHS-05, and MHS-07 (Figure 2-2) were each outfitted with Yellow Springs Instruments (YSI) water quality meters at a depth equal to 0.2 multiplied by the mean low-low water (MLLW) channel depth. Stations MHS-01 and MHS-06 were each outfitted with a second YSI meter mounted 1 m above the sediment bed." The approximate river depth of the stations should be provided so the reader can understand how 1m monitoring stations compare to 0.2xMLLW depth stations (e.g., will the data be comparable or are some are near the bottom while others are near the surface?).

Response: The following table summarizes the height above the mudline at which the YSI meters are installed. These data will be provided in future discussions and analyses of the BCSA monitoring data.

Station	Distance from Mudline to Sensor (m)
MHS-01 (BCC) (upper)	2.65
MHS-01 (BCC) (lower)	1.00
MHS-02 (LBC)	1.16
MHS-05 (MBC-Outfall)	2.08
MHS-06 (UBC-PP Rd.) (upper)	0.86
MHS-06 (UBC-PP Rd.) (lower)	0.42
MHS-07 (UBC)	0.96

35. Section 2.1.2.4, Page 2-7: A brief description of bathymetric data by reach should be included in the text.

Response: A brief description of the bathymetric data will be included in the Phase 2 Report and RI Report. A detailed description of site-wide bathymetric data for the main stem of Berry's Creek was presented in Appendix IV (Bathymetric Final Report) of the "Geophysical Investigation of Surface and Subsurface of Berry's Creek and Berry's Creek Canal Study Area (BCSA)", submitted to USEPA in June 2008, and is available on the USEPA Deliverables Website.

36. Section 2.1.2.6, Page 2-8, Second and Fourth Paragraphs: The text discusses observed flows in the East and West Risers; however, the quantities provided have units of velocity. Clarify that quantities provided are the velocity measured.

Response: The reviewer is correct in assuming the quantities provided are velocity (m/s), not discharge.

37. Section 2.1.2.6, Page 2-8, Last paragraph: The use of sediment traps in the risers should be evaluated (with potential analysis of collected sediment for COPCs and physical properties) or other sampling techniques consider to further characterize sediment transport. Deployment of sediment traps over a period of two weeks or more could allow integrated sampling of sediment transported during low flow and wet weather conditions and simplify scheduling and deployment of field teams.

Response: The Group has revised the proposed Phase 2 scope of work to better characterize sediment transport into the study area from the uplands (Section 3.1.6 of the revised Phase 2 Work Plan). The use of sediment traps was evaluated by the Group but determined to be inappropriate for COPC and physical characterization of sediments in a tidal setting. As presented during the August 4, 2010 work session with USEPA, in tidal settings a thin veneer of fine sediments (the "fluff layer") is deposited during slack tide phases and resuspended with the subsequent rising or falling tide. As the name implies, sediment traps are designed to capture all deposited sediments and thus prevent resupension of captured sediments back to the water column. By preventing the naturally-occurring efflux of the fluff layer sediments, sediment traps over estimate sediment deposition rates. Further, the chemistry and physical properties of the trapped sediments are skewed towards that of the fluff layer and may not be representative of sediments accreting in the area over the longer term. Characterizing upstream sediment inputs using sediment traps therefore is not feasible since the risers are subject to tidal influence in the area of interest due to leaky tide gates.

As presented in Section 3.1.6 of the revised Phase 2 Work Plan (Geosyntec, April 2011), the Group has proposed monitoring at selected storm water outfalls/tributary ditches to the BCSA in lieu of sediment traps. The proposed monitoring program will a) estimate representative long term flow rates from these locations, b) support the estimation of annual sediment loading from the uplands, and c) evaluate the storm hydrograph and quantify suspended solids concentrations during two major storm events. These data will provide an empirical basis for quantification of the water flow and suspended sediment flux associated with these inputs, and, in conjunction with other lines of evidence (e.g., response in turbidity levels at the moored stations to a storm event), will support the analytical modeling efforts related to sediment flux.

38. Section 2.1.3.1, Page 2-11: Although turbidity levels may increase in reaches closer to the Hackensack River during spring tides, the PRPs should also state that turbidity levels are generally lower closer to the Hackensack River and higher in the upper reaches (UBC) as observed in summary table provided in text.

Response: Based on a review of the data presented in the referenced summary table, the average high tide turbidity was similar in BCC and UBC; average low tide turbidity was slightly higher in UBC. The minimum turbidity measured during the three quarters available at the time the Phase 1 report was submitted was measured in UBC (5.1 NTU), and the maximum turbidity was measured in BCC (183.4 NTU). Patterns in water quality parameters will be further evaluated at the conclusion of Phase 2. Please refer to the response to Comment #17 regarding Phase 1 report revisions.

39. p. 2-12: Temperatures reported are Celsius not Fahrenheit as noted in table.

Response: Agreed, comment noted.

40. Section 2.1.3.1, pp. 2-12, dissolved oxygen - Based on the data shown on the table on 2-13, it does not seem appropriate to say that the highest DO levels are observed during low tide.

Response: Based on a review of the indicated text, the statement is accurate as presented. The text states that the DO concentrations were *typically* highest during low tide; the only exceptions to this statement are the minimum and average values recorded at stations BCC and PPR (Paterson Plank Road). Patterns in water quality parameters will be further evaluated at the conclusion of Phase 2.

41. Section 2.1.3.1, Page 2-13: For seasonally-variable parameters, such as Dissolved Oxygen, it would be better to organize the data table presentation by season and then by minimum, maximum, and average.

Response: Comment noted. The Group will evaluate alternative means of presenting the water quality data during the Phase 2 data analysis.

42. Section 2.1.3.1, pp. 2-13, dissolved oxygen – The table included lots of values that show levels of supersaturation of oxygen. Please confirm that these values are correct, as the system seems to have numerous occurrences with this condition. If there is supersaturation during the day, because of algal blooms, then what happens at night time? Often the respiration at night can deplete dissolved oxygen to levels insufficient to support fish populations. Further evaluation of this is warranted.

Response: The dissolved oxygen concentrations presented on page 2-13 are correct. All monitoring stations exhibited periods of both oxygen supersaturation and hypoxia, consistent with scientific literature regarding estuarine water quality. Dissolved oxygen saturation is known to vary widely in estuarine systems on diurnal, seasonal, and interannual timescales (e.g., Wenner et al, 2004). Instances of oxygen supersaturation are often attributable to photosynthetic activity, though supersaturated conditions do not necessarily imply the existence of algal blooms. The solubility of oxygen at 25°C and zero salinity is approximately 8.2 ppm O_2, and solubility decreases as temperature and/or salinity increase (USGS, 2006). Fluctuations in dissolved oxygen concentrations with respect to season, time of day, and tide stage are therefore to be expected. Dissolved oxygen concentrations were not evaluated with respect to time of day as part of the Phase 1 analysis. Patterns in water quality data, including dissolved oxygen, will be further evaluated at the conclusion of Phase 2.

43. Page 2-17, UBC Transects, first bullet: Please provide an explanation for not collecting water level data for transect UBC-5.

Response: The Phase 1 Work Plan (Section 8.1.1.3; Geosyntec/Integral, 2009) specified that pressure transducers would be installed at selected marsh locations to monitor tidal inundation, based on a detailed review of the marsh survey data. The general marsh elevations, variability in elevations within a given transect, comparison between marsh elevations and tidal elevation ranges, the presence of unique water features along transects, and the distribution of transects across the system were all considered in determining where to install transducers for water level monitoring. Transect UBC-5 was not selected for additional water level monitoring due to its extremely flat topography and the selection of four other UBC transects for monitoring (the most of any study segment). In the interest of collecting sufficient data in other BCSA segments, water level data were not collected in UBC-5.

44. Section 2.1.3.2, p. 2-19, bottom of third paragraph – Starting at "prepatory…." These sentences are confusing. State which party implemented the action.

Response: Sediment removal in the vicinity of the West Riser Tide Gate was conducted by Morton International, consistent with the USEPA-approved Sediment Removal Action Work Plan. The sediment removal was conducted to fulfill the requirements of an Administrative Order on Consent (AOC) between Morton and USEPA. Future descriptions of this work will note that is was completed by Morton.

45. Section 2.1.3.3, p. 2-21, 2nd paragraph – Several of the flow numbers in this paragraph have incorrect units as shown.

Response: Two unit errors were identified in the second paragraph of p. 2-21. The sentences should read as follows:

"Over this time period, the BCSA is estimated to have had an average net freshwater flow to the Hackensack River of 1.5 m^3/s. As discussed in Section 3.2.1, this flow represents <8 percent of the average BCSA tidal flow (20.3 m^3/s) and is *de minimis* (<0.5 percent) relative to the tidal flow in the Hackensack River."

46. p. 2-21: Over four months, the report notes there was very little net freshwater from the creek into the Hackensack River. This may be an artifact of the analysis given that the number is obtained by subtracting a very large quantity from a similarly large quantity, and neither is known to the 1 m^3 degree of accuracy.

Response: The uncertainty in the freshwater flow estimate is acknowledged in the second paragraph of page 2-21. The cause of this uncertainty (i.e., the fact that the tidal influx to and tidal efflux from the BCSA are large and nearly equal) clearly demonstrates that the freshwater flow is small relative to the tidal flows (i.e., if freshwater flows were large, the difference between the tidal efflux and influx would be greater and the calculation less uncertain). Consistent with many hydrodynamic aspects of an estuarine system such as the BCSA, quantifying freshwater flows is complex and requires multiple lines of evidence to reduce uncertainty. Uncertainty in this calculation will be reduced as additional data are collected for the system and the calculations are tested against other lines of evidence. The calculations presented in the Phase 1 Report are consistent with the current understanding of freshwater inputs to the system based on the water budget and on the observed salinity gradient across the BCSA. Substantial additional measurements of freshwater inputs will be collected during Phase 2 (refer to Section 3.1.6 of the revised Phase 2 Work Plan), and the water budget will be discussed further in the Phase 2 Report.

47. p. 2-22: Figure 2-15 doesn't look as decisive as the text argues. Maybe slightly more than half of the pairs are above the 1:1 line (indicating deposition) but there are almost as many that are below the line. Sometimes those below may represent periods of high runoff, as suggested in the text, but not always (e.g., there's also one where the ebb value is about 35 and the flood value is 10, so both are quite low).

Response: The referenced text discussing data above and below the 1:1 line was intended to explain potential interpretations of this particular style of data presentation, rather than to indicate definitive evidence of deposition. As stated in the Phase 1 report text, additional analyses are required to understand sediment dynamics in the BCSA. The Phase 2 scope of work has been revised to further characterize sediment transport in the study area (refer to responses to Comments #3 and #7).

48. Section 2.1.4.1, Page 2-23, Third Paragraph: Preliminary sediment flux calculations should be completed using available TSS data.

Response: The available TSS dataset was limited to three quarters of monitoring at the time the Phase 1 Report was submitted, and the correlation to turbidity, for which there was a more robust dataset, was relatively weak (see Phase 1 Report, Figure 2-16). The Group therefore determined that attempting to calculate a sediment balance using the data available at the time would not provide meaningful information. Additional TSS measurements will be collected in Phase 2 (refer to response to General Comment #3), and sediment flux calculations will be reevaluated based on the complete Phase 1 and Phase 2 dataset.

49. Section 2.1.4.3, Page 2-24, Last bullet: In this bullet (and also in Appendix O and other relevant sections of the report that discuss sediment core geochronology), the text should be modified to identify some of the potential limitations of the evaluation of sediment core Cs-137 data. Due to the potential for sediment transport due to storm events and anthropogenic activities, the deepest detection of Cs-137 in a particular core may not represent the 1954 horizon (although the sediments are certainly from 1954 <u>or</u> a more recent date) and the peak detection of Cs-137 in a core may not represent 1963 because the 'true' peak sediment may have been eroded or removed at some point. Discontinuous core profiles can confound attempts to estimate deposition rates and additional criteria for evaluation of profiles are required, for example, at least a 0.5 pCi/g detection of Cs-137 to confirm the presence of the 1963 sediment horizon.

Response: Comment noted; please refer to the response to Comment #17 regarding Phase 1 report revisions. Potential limitations of Cs-137 data will be taken into account during analysis of the combined Phase 1 and Phase 2 geochronology dataset, and noted in the Phase 2 report.

50. Section 2.1.4.3, Page 2-25, First bullet: In this bullet (and also in Appendix O and other relevant sections of the report that discuss sediment core geochronology), the text should be modified to identify some of the potential limitations of the evaluation of sediment core lead-210 (Pb-210) data. Changes in the Berry's Creek watershed over history, including the construction of the Oradell Reservoir and increasing upland development, have likely contributed to changes in Pb-210 deposition and are likely to confound attempts to calculate deposition rates that assume constant deposition. Downcore Pb-210 profiles may be of extremely limited utility in this system.

Response: Comment noted; please refer to the response to Comment #17 regarding Phase 1 report revisions. Potential limitations of Pb-210 data will be taken into account during analysis of the combined Phase 1 and Phase 2 geochronology dataset, and noted in the Phase 2 Report. Historical changes to the BCSA watershed and Hackensack Meadowlands that may have influenced sediment deposition will be evaluated as part of the Phase 2 investigation (Task 8 – Regional Background Data Review). The potential effect of these changes on interpretation of geochronology data and calculation of sediment deposition rates will be taken into account during the Phase 2 data analysis.

51. Section 2.1.4.3, Page 2-25, First Bullet and Page 2-27, Third Bullet: The report states that the Be-7 "data were evaluated in a qualitative fashion to identify areas with deposition in the past several months; any positive readings were found to be indicative of recent deposition" (page 2-25). A surface sediment concentration map for Be-7 bearing sampling locations only should be included. In order to evaluate recent deposition utilizing Be-7, a separate program to re-occupy the Be-7 bearing sampling locations from Phase 1 with the collection of a 0-2 cm sediment sample and analysis for Be-7, PCB (congeners?), mercury, and methylmercury should be considered. This would provide better information with respect to the resuspension and transport in the system.

Response: Please refer to the response to Comment #10.

52. Section 2.1.4.3, Page 2-25, Second Bullet: The placement on pre-1950 material (non-detected Cs-137) on top of post-1950 material (Cs-137 bearing) indicates a physical discontinuity in the core and the assumption of constant deposition does not hold. Consequently, cores are not datable (including cores 134, 137, 138, 139, 140, 167, and 183). Calculation with the "cesium horizon method" needs additional justification.

Response: Potential sources of uncertainty associated with interpretation of geochronology results will be evaluated in detail and discussed further in the Phase 2 Report. Non-detect results for ^{137}Cs do not automatically indicate that the associated sediment was deposited before 1954. Theoretical and observed profiles of ^{137}Cs, such as in Zapata (2002), show that deposited ^{137}Cs activities decrease steadily in more recent time. Hence, we would predict that shallow samples, assuming they represent recent sediment, would have relatively low ^{137}Cs. Additionally, the presence of sand, to which radionuclides do not strongly sorb, may contribute to non-detect results for ^{137}Cs in some samples.

Despite this, it is possible, as noted in several core interpretations presented in Appendix O of the Phase 1 Report, that discrete intervals of pre-1954 sediments may have been deposited in relatively shallow horizons overlying post-1954 sediments as indicated by ^{137}Cs presence. These intervals may be due to the erosion of old (pre-1954) soils in upland or marsh areas due to unusually high-energy storm events or changes in upland development patterns. While it is therefore possible that some discontinuity may exist in some of the cores (e.g., the majority of the core results from gradual deposition of recent waterborne sediments, whereas discrete intervals of atypically-aged sediment are added through episodic, high-energy storm events), such behavior does not automatically render the entire core of no value for quantitative interpretation. If most of the core presents a coherent trend for interpretation, it is reasonable to proceed with deposition rate estimation accepting that the interruption of the core by limited, episodic events of discontinuous deposition may introduce limited error to the arithmetic in the analysis.

53. Section 2.1.4.3, Page 2-25, Second Bullet: The identification of potential 1954 and 1963 horizons from Cs-137 data should be confirmed, to the extent possible, by evaluation of downcore COPC profiles based on contaminant production/release history.

Response: Downcore COPC profiles were evaluated in conjunction with the geochronology data in Appendix O of the Phase 1 report. Geochronology data (including Phase 2 high resolution cores) will continue to be evaluated with respect to COPC profiles in Phase 2.

54. Section 2.1.4.3, Page 2-27: Summarize geomorphological settings for the cores that are identified as depositional locations.

Response: The Group will conduct an analysis of depositional patterns with respect to geomorphological setting as part of the Phase 2 analysis.

55. p. 2-28 second to last bullet: The last sentence is confusing because of the verb tense of "reaching". Is the statement that BCC was built with excess capacity so it is hasn't yet reached equilibrium (i.e. it is currently in the process of reaching equilibrium or it has reached and maintained equilibrium)?

Response: The sentence intended to state that the geochronology data from Phase 1 indicate that deposition is still occurring in BCC, and that equilibrium has not been reached. However, this analysis will be re-evaluated as part of Phase 2.

56. p. 2-29, Section 2.2, General Comment: In general, the text only considers precipitation events as the cause for the observed contaminant distribution; however, the data do not show a clear correlation. Other contributors should be considered as well such as tidal influence, turbidity, and resuspension.

Response: The Group recognizes that precipitation events are not the only factor contributing to the observed distribution of COPCs in BCSA surface water. Tidal influence (flow velocity direction) was taken into account in both the discussion (page 2-33, first bullet; page 2-34, second bullet) and the data presentation on Figures 2-20a-h (flow direction and magnitude indicated by arrows inset in symbols). However, tidal influence appeared to have a relatively small effect on COPC distribution based on the three quarters of monitoring data evaluated. The difference in COPC detection frequency between wet and dry monitoring events appeared to be more apparent than the difference between flood and ebb tide, particularly for mercury and PCBs. The influence of suspended particulates on COPC fate and transport was also evaluated through a comparison of paired filtered and unfiltered sample results (pages 2-35 and 2-36, and Figures 2-22a-d). The factors influencing COPC distribution, transport, and fate will continue to be evaluated during Phase 2, and the findings will be updated in consideration of the combined Phase 1/Phase 2 dataset. The importance of resuspension in the BCSA is a focus of the Phase 2 scope of work, as discussed in the response to Comment #7 and presented in the revised Phase 2 Work Plan (Geosyntec, April 2011).

57. Section 2.2.2, p. 2-30, Figures 2-20(a-h) and Figures 2-24 to 2-26: The white text for location labels is not very legible.

Response: Comment noted. Figures will be evaluated more closely for legibility in future deliverables.

58. Section 2.2.2, Page 2-30, First Paragraph: Revise the Appendix K tables that are list in text, which should read K12 through K16, not K7 through K11.

Response: The reviewer is correct, the text should reference Appendix K tables K12 through K16. Please refer to the response to Comment #17 regarding Phase 1 report revisions.

59. Section 2.2.2.1, Page 2-32: The Phase 1 Report states, "An important consideration in the evaluation of the data is precipitation events during the sampling event, as described in Section 2.2.1 above." Important considerations should also include time of year and point in tidal cycle when sample was taken.

Response: Please refer to the responses to Comments #41 and #56. The factors potentially influencing COPC concentrations in surface water (seasonality, tidal influence, suspended sediments, etc.) will be evaluated in consideration of the combined Phase 1 and Phase 2 dataset.

60. Section 2.2.2.1, Page 2-32, Second to Last Bullet: The text should reference the tables with the data being discussed.

Response: The text should reference Appendix K, Tables K12 through K16.

61. p. 2-32: It is unclear whether transport of dissolved phases of contaminants such as Hg is being accounted for.

Response: As specified on page 2-32, the discussion relates to unfiltered (total) concentrations of mercury and other COPCs. The discussion of filtered (dissolved) vs. unfiltered (total) COPC concentrations begins on page 2-35 of the Phase 1 Report.

62. Section 2.2.2.1, Page 2-32 to 2-34, All Bullets: Revise the concentration ranges shown on Figures 2-20(a-h) to match the concentration ranges discussed in the text. For example, in the text unfiltered total mercury is reported as a 0.01 to 0.3 μg/L concentration range, while Figure 2-20a shows ≤0.05 μg/L, >0.05 -0.21 μg/L, and >0.21 – 0.76 μg/L.

Response: The comment regarding consistent concentration ranges in text and figures will be addressed during preparation of the Phase 2 Report. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

63. Section 2.2.2.1, Page 2-33: More discussion should be included regarding the conclusion that ebb and flood tide water column mercury concentrations are similar (automated quarterly samples), with respect to boundary conditions and other factors.

Response: More detailed analysis of ebb vs. flood tide surface water COPC concentrations will be included in the Phase 2 Report. Please refer to the response to Comment #17 regarding revisions to the Phase 1 report.

64. Section 2.2.2.1, Page 2-33, First Bullet: Tidal influence should be considered as being related to the contaminant distribution. Data provided on the associated figures should be reviewed in more detail.

Response: Tidal influence (i.e., ebb vs. flood tide conditions) on COPC distribution was considered in the first bullet on page 2-33. Please refer to the response to Comment #63.

65. Section 2.2.2.1, Page 2-33, Last Bullet: The associated figures do not agree with the conclusions provided in the text.

Response: The Group has reviewed the referenced text and associated figures and determined that the findings as originally stated are consistent with the data presented on the figures. While trends in surface water metals (cadmium, chromium, manganese, and zinc) concentrations are not necessarily consistent between metals or among sampling events, the text presents an accurate general description of the observed patterns. Trends in surface water COPC concentrations will continue to be evaluated in Phase 2, and will be discussed further in the Phase 2 Report.

66. Section 2.2.2.1, Page 2-34, First Bullet: The information provided in this bullet (regarding an equipment malfunction in the laboratory) should be mentioned as a caveat in the previous bullet while discussing the results. .

Response: This comment will be taken into consideration during the preparation of the Phase 2 Report. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

67. Page 2-34, third paragraph: Based on the information provided, it does not appear that total unfiltered PCB detection were "sporadic". They were consistently found in all sampling quarters, albeit at different frequencies, and a slight north – south gradient was observed in all three events.

Response: Comment noted. PCBs were detected at most sampling locations during the first and third quarters (wet events) but only at a limited number of locations during the second quarter (dry event). The fourth sentence of the referenced text identifies the north-south gradient in all three sampling events, as noted by the reviewer.

68. Section 2.2.2.1, Page 2-34 to 2-35: Please review the conclusions drawn with respect to the "Transect Graphs" Figures 2-21(a-h). Agency reviewers have interpreted these differently.

Response: The Group has reviewed the referenced text and figure and determined that the findings as originally stated are consistent with the data presented on the figures. The Group is not clear how the reviewers interpreted the figures. Trends in surface water COPC concentrations will continue to be evaluated in Phase 2, and will be discussed further in the Phase 2 report.

69. Page 2-35, last paragraph, last sentence: "Evaluation of filtered data in comparison or in addition to unfiltered data serves multiple purposes. It allows a refinement of the CSM of COPC fractionation between particulate and dissolved/fine particulate phases and the attendant implications for COPC transport. It also supports an evaluation of exposure point concentrations that is more relevant than unfiltered concentrations for ecological and human health receptors. It is for this reason that surface water ARARs are best compared to filtered surface water data as opposed to unfiltered data." Surface water ARARs are best compared with unfiltered samples for an RME scenario as human receptors are likely to contact the whole water. Filtered results may underestimate EPCs. It may be useful to screen both unfiltered and filtered data sets.

Response: Subsequent evaluations of surface water data will consider dissolved and total concentrations, if appropriate. The aquatic life New Jersey Surface Water Quality Standard (NJSWQS) for metals, for example, are explicitly expressed as a dissolved criteria, and therefore, comparisons to total concentrations are not consistent with the intent of the criteria. The saline waters human health NJSWQS were developed to protect humans from consumption of fish (not water), and therefore, comparison to dissolved chemical concentrations (which best represents the bioavailable fraction for uptake) was deemed appropriate. Future risk evaluations will utilize total or dissolved concentrations depending upon the exposure route being evaluated.

70. Section 2.2.2.1, Page 2-36, First Bullet: The text reads "While filtered mercury (Figure 2-22a) was detected in all surface water locations, concentrations were generally far below the associated freshwater or saline standard." Please review the conclusions drawn, as agency reviewers have interpreted the figure differently.

Response: The Group has reviewed the referenced text and figure, and has determined that the conclusion as originally stated is consistent with the data presented on the figure. A limited number of filtered mercury results exceeded the NJSWQS for freshwater in one study segment (UBC) during the first quarter only. Filtered mercury exceedances of the more stringent saline SWQS occurred in UBC and MBC in the first and third quarter. However, filtered mercury concentrations were below both the freshwater and saline SWQS in all other segments for all other sampling events. The Group is not clear how the reviewers interpreted the figures. Trends in surface water COPC concentrations will continue to be evaluated in Phase 2, and will be discussed further in the Phase 2 Report, as well as with the USEPA reviewers.

71. Page 2-36, second bullet: Reporting filtered PCB detections as "rare" may downplay the importance of PCBs in the water column. The number of detections in filtered water was greater than 5% of the total and several samples exceeded the ARAR.

Response: Appropriate terminology to describe infrequent detections will be considered during the preparation of the Phase 2 Report. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

72. Section 2.2.2.1, Page 2-36, Third Bullet: The conclusions drawn from Figures 2-22(c-d) for cadmium regarding detected data, and for chromium and zinc regarding the associated freshwater or saline standard, were interpreted differently by agency reviewers. Please review the conclusions.

Response: The Group has reviewed the referenced text and figures, and has determined that the conclusions as originally stated are consistent with the data presented on the figures. The Group is not clear how the reviewers interpreted the figures. Trends in surface water COPC concentrations will continue to be evaluated in Phase 2, and will be discussed further in the Phase 2 report.

73. Section 2.2.2.2, Page 2-37: Agency reviewers has interpreted the associated figures

(Figures 2-23[a-f]) differently than the conclusions provided in the text. Please review.

Response: The Group has reviewed the referenced text and figures, and has determined that the conclusions as originally stated are consistent with the data presented on the figures. The Group is not clear how the reviewers interpreted the figures. Trends in surface water COPC concentrations will continue to be evaluated in Phase 2, and will be discussed further in the Phase 2 report.

74. Section 2.3.3, Page 2-41, Second Bullet: The legend for graphics that are similar to Figure 2-31 (and associated text) need to be clarified since it is unclear whether surface and/or subsurface concentrations are presented for the bedforms called "Intertidal," "subtidal," and pool.

Response: Comment noted. The data presented in the referenced figures are for surface sediments only. Clarity of figure legends/titles with respect to the text and data presented will be further evaluated during preparation of the Phase 2 report.

75. Section 2.3.3, Page 2-42, First Bullet: The analysis depicted in Figure 2-32 (and any similar figures) likely has limited usefulness. These graphics show arithmetic averages of sediment concentrations per depth intervals. However, the averaging by depth interval neglects to take into account differing sedimentation rates at each location, so that different sediment horizons (i.e., different years of deposition and contaminant loading) may be grouped together.

Response: The Group acknowledges the limitations inherent in this method of analysis. As discussed in Section 2.3.3.3, a comprehensive presentation of individual COPC profiles by core is available in Appendix O. Figures 2-32a-b were developed to summarize the typical relationships between COPC concentrations and depth, as differentiated by study segment and depositional status. The Group recognizes that the averaging process will, by its nature, combine concentrations representing different age ranges. The purpose of this analysis was not to characterize concentrations as a function of sediment age, which would be important for evaluating potential sources. Rather, the objective was to understand the concentration-depth relationships in general terms, which is relevant for evaluating potential exposure concentrations for risk assessment and remedial alternatives analysis.

76. Section 2.3.3, Page 2-42, Second Bullet, Section 2.3.3.6, Page 2-53; and Figure 2-43: EPA agrees that it is likely that one main source of polychlorodibenzodioxins/furans (PCDD/F) to Berry's Creek is tidal interactions with Newark Bay. However, the information selected may overstate this assessment. For example, Footnote 1 in Figure 2-43 indicates that it includes sediment data from <u>all depths</u> in Newark Bay. (No footnote was provided to explain the data source for the Lower Passaic River and the associated wide error bar.) However, no *mechanism has been proposed to explain how sediment buried in Newark Bay might impact Berry's Creek. This analysis should have been conducted including only 2,3,7,8-Tetrachlorodibenzodioxin (2,3,7,8-TCDD) concentrations in surface sediments or on suspended solids, since these are the solids most likely to be transported with the tides and impact Berry's Creek.*

Response: The objective of the analysis in Section 2.3.3.6 was to evaluate the potential for BCSA-specific sources and to facilitate comparative analysis between study segments, as well as to evaluate regional conditions that may have led to the presence of dioxins in the study area. Within the study area, a decreasing concentration gradient is evident with distance from the Hackensack River, supporting the absence of BCSA-specific sources.

The regional analysis utilized readily available data from other studies. The footnote identifying the data source for the Lower Passaic River was inadvertently left off of Figure 2-43, and the complete citation (Ehrlich, 1994) is included in the References section of this document. These data are for surface sediments (0-5 cm) in the Lower Passaic River, and the error bar reflects the reported range of concentrations. Data originally presented for Newark Bay were derived from the summary statistics (Tables 4-13 and 5-13) presented in the *Phase 1 and Phase 2 Sediment Investigation Field and Data Report* (Tierra, 2008) for all data. Tierra (2008) presented surface sediment summary statistics for 2,3,7,8-TCDD only (Tables 4-27 and 5-25), which would not have been sufficient to compare PCDD/F fingerprints as shown in Figure 2-47. Although the average surface sediment TCDD concentration is lower than the average for all sediment depths, the conclusions presented in Section 2.3.3.6 of the Phase 1 Report do not change. More detailed evaluation of regional COPC concentrations is proposed in Phase 2 (Task 8 – Regional Background Data Analysis), and potential regional contributions to BCSA sediment COPC concentrations will be evaluated further in the Phase 2 report. Figure 2-43 will be revised to reflect surface sediment concentrations if additional analysis of dioxin/furan concentrations is undertaken in future deliverables.

77. Page 2-42: While VOCs and SVOCs are not predicted to play a significant role in management decisions for the site, risk assessment guidance recommends that they should still be carried through human health and ecological risk assessments since some detections were above screening levels.

Response: As agreed with USEPA previously, these compounds will be considered in the human health and ecological risk assessments. In fact, the Phase 2 RI includes VOC and SVOC analysis for a subset of samples to provide additional data to support these assessments. However, it is consistent with both human health risk assessment guidance (RAGS Part A[1]) and ecological risk assessment guidance (ERAGS[2]), as well as USEPA's

[1] USEPA. 1989. Risk Assessment Guidance for Superfund. Volume 1. Human Health Evaluation Manual (Part A). EPA/540/1-89/002.

sediment management guidelines, to focus the risk assessment on those compounds that pose the most significant risks (see for example RAGS Part A section 5.9.5, or ERAGS discussion in section 3.2 on refinements of contaminants of concern.) The Group maintains that this focus on risk drivers, in conjunction with the agreement to consider VOCs and SVOCs in the final baseline assessments, provides sufficient data to support the development of protective yet targeted management options for the site.

78. Section 2.3.3.3, Page 2-43: In the Phase 1 Report, average sediment concentrations were used for making comparisons between study segments. Straight averages on non-random samples may not be appropriately representative of actual conditions. Analysis of the data should incorporate a spatial component so that areas with a greater sampling density do not bias the data. For example, if sampling has focused many samples in areas of elevated contamination but in a limited spatial area and few samples in a much larger area with low concentrations, the straight average of all samples may be more elevated than if sampling and analysis included a spatially-weighted component.

Response: Please refer to the response to Comment #14 regarding sampling design, and the response to Comment #95 for additional discussion of area-weighted averaging.

79. Page 2-49, discussion of COPC concentrations at each depth interval: It would be helpful to include screening levels for reference.

Response: Comment noted; please refer to the response to Comment #17 regarding revisions to the Phase 1 Report. Additional references to screening levels will be included in the Phase 2 Report as appropriate.

80. p. 2-50, Section 2.3.3.4, PCBs: An explanation of how Aroclors 1248, 1254, and 1260 were summed should be included.

Response: The concentrations of these three Aroclors were summed for each sample, using a concentration of zero for non-detects (i.e., summations only included detected Aroclors). In samples in which none of the three Aroclors was detected, the total PCB concentration value was indicated as "ND" (not detected) for the purposes of tables and figures, and a value equal to the greatest of the reporting limits for each of the three Aroclors was used as the total PCB concentration in cases where averaging with other samples was necessary.

81. Section 2.3.3.5, Page 2-52: It is stated that the biologically active zone (BAZ) PCB

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[2] Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducing Ecological Risk Assessments. EPA 540-R-97_006.

concentrations in the tributaries (West Riser, East Riser, Peach Island Creek) were less than intermediate concentrations, indicating both the likelihood of recent deposition as well as a possible tendency of PCBs to act somewhat differently than metals due to their hydrophobicity. This should be stated more clearly. (It is assumed that it is trying to say that the surface sediment concentration are less than subsurface concentrations.)

Response: The intent of this statement was to indicate that, in the tributaries, BAZ concentrations were lower than concentrations in deeper sediments.

82. p. 2-52, Section 2.3.3.5, Pesticides: The report notes, "Only three pesticides, aldrin, beta BHC, and heptachlor epoxide, were observed in concentrations that exceeded the observed levels in the Reference Sites." Screening out of contaminants based on concentrations in areas potentially affected by the site rather than by the potential effect of the contaminant itself is not appropriate. For example, chlordane concentrations in BCSA sediment exceed sediment benchmarks but are not evaluated. While pesticides are not predicted to play a significant role in management decisions for the site, risk assessment guidance recommends that they should still be carried through human health and ecological risk assessments since some detections were above screening levels.

Response: Site-related chemicals that are detected frequently and above regional background concentrations and screening-level risk benchmarks will be considered in the baseline risk assessments, though as noted in USEPA's comment above, most of these compounds are not predicted to be important in the risk management decisions for the site. Use of reference sites to identify site-related conditions is consistent with CERCLA, Superfund risk assessment, and sediment management guidance, and the Group maintains that consideration of regional background conditions is necessary to support the development of realistic and achievable sediment management strategies for the site. The Group has previously provided information to USEPA that supports the use of the selected reference sites to represent regional background conditions that are unaffected by the site. Additional analysis of regional background concentrations of COPCs is proposed as part of the Phase 2 scope of work (Task 8 – Regional Background Data Analysis), and the results will be considered in the evaluation of site-specific COPCs. The Group can provide additional information in the Phase 2 or RI/FS Report, as requested, to evaluate the potential that chemicals from the site were transported to the selected reference areas.

83. Section 2.3.3.6, Page 2-53 and Figure 2-44 and Figure 2-45: When calculating a TEQ for a sample, concentrations of PCDD/F congeners and dioxin-like PCB congeners are incorporated into the summation. While one sampling location may have a high TEQ because of elevated PCDD/F concentrations, another sampling location may have an equally high TEQ value because of elevated PCB congeners. Figures 2-44 and 2-45 do not include the dioxin-like PCB congeners in the summation as that data was not collected in Phase 1. This is one of the arguments for conducting analysis of PCB congeners in subsequent phases. Without that *information it is inappropriate to refer to the data on these figures as total TEQ.*

Response: As indicated in the comment, the TEQ values presented in the figures are representative of dioxin/furan TEQ rather than total TEQ. Refer to the response to General Comment #6 regarding congener analysis. Future documents will specify whether TEQs are totals dioxin/furan only or PCB dioxin-like congeners.

84. Section 2.3.3.6, Page 2-54: It is noted that no further data collection for dioxins and furans is needed to complete the RI/FS for the BCSA. Further justification should be provided prior to making this decision, as the concentrations within Berry's Creek exceed screening levels, and therefore should be evaluated in the risk assessments.

Response: Please refer to the response to Comment #16 regarding risk assessment of dioxins.

85. Section 2.3.4, p.2-54, Non-COPC Stressors: The report notes, "In other cores, BOD levels decrease with depth, which may indicate the ultimate consumption of BOD over time" or could it represent areas where erosion has occurred? Also the presence of industrial chemicals can impact BOD and should be noted here.

Response: The Group reevaluated the cores that demonstrated decreasing BOD concentrations with depth (TBZ-116, TBZ-141, TBZ-142, TBZ-149, TBZ-159, TBZ-167, TBZ-169, and TBZ-185). Of these eight cores, five showed evidence of net deposition since 1954 so erosion is unlikely to explain the observed trend at these locations. Insufficient data are available to determine whether the observed decrease in BOD with depth may be attributed to consumption of BOD, erosion, or other factors. A subset of the Phase 2 sediment samples will be analyzed for BOD. The combined Phase 1 and Phase 2 BOD results will be evaluated in the context of geochronology and COPC data, and discussed in the Phase 2 Report.

86. p.2-58, Sect 2.5.2 - Clarify if the annual Atmospheric Deposition values are for the entire watershed or per acre or other area. How does this rate compare to other atmospheric deposition rates observed in the region?

Response: These mass loading estimates are based on estimated annual loading rates for the entire Berry's Creek Study Area, which has been defined for the purposes or the RI/FS as the watershed (i.e., "the site" as stated in the report). For the purpose of the Phase 1 Report, atmospheric deposition fluxes from the Jersey City station were used to calculate mass loading estimates for the BCSA, given this station's similar urban character and proximity to the BCSA. Based on data obtained by the NJ Atmospheric Deposition Network, mass loading is comparable across all urban locations in the region (e.g., Jersey City, New Brunswick, Camden), and higher than that in non-urban sites.

87. Page 2-63, third paragraph: "Vandalism limited the number of days deployed for the BCC camera, and equipment failure limited the number of days that the Route 3 and LBC cameras were deployed and recording." This statement supports EPA's previous comment in the Exposure Scenarios and Assumptions comment memo that the camera study should be treated qualitatively as observational data to help support our best professional judgment on activities and exposure parameters.

Response: The camera surveys of human use will be continued at three locations: Paterson Plank Road, Route 3 Bridge and Berry's Creek Canal. The objective is to ensure a robust data set, as well as data from additional seasons to reduce uncertainty in the frequency and duration of human activity.

88. Page 2-64, second and third paragraphs: Were 17 fish species identified or 17 in addition to white perch and mummichog?

Response: Seventeen species were identified in total, with mummichog and white perch accounting for the vast majority of total abundance. The remaining 15 species accounted for less than one to four percent of the total catch.

89. Page 2-64, fifth paragraph: Please indicate that white perch were found in large numbers in UBC during spawning in the spring as was discussed during the presentation.

Response: Factors contributing to fish abundance and distribution (including spawning) will be further discussed in the Phase 2 Report. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

90. p. 2-64: The report states, "Variability in abundance and community composition of species across reaches and throughout the seasons is likely due to a number of environmental factors including salinity, dissolved oxygen, temperature, prey availability and physical habitat, as well as life history characteristics." This observed variability likely will greatly limit the ability to detect community differences between sites.

Response: Variability in aquatic community metrics is predicated on the inherent variability which occurs among environmental conditions in Berry's Creek. Because estuarine systems exhibit fairly broad changes in environmental conditions, relatively few aquatic species have adapted mechanisms and natural histories to cope with such changes (thus accounting for the relatively low species diversity characteristic of estuarine systems). Variability in environmental conditions also determines the distribution and abundance of individuals at a given point in time, and a collection of fish from a trawl, for example, represents one snapshot in time. The emphasis of the BCSA community survey work has been two-fold in nature. First, the survey work has provided site-specific data on community metrics in areas of Berry's Creek and reference areas where data had been lacking. Second, while variability in environmental conditions is known to naturally control community composition and abundance, the survey work considered whether large differences exist among communities that may be suggestive of the other determinants beyond variable environmental conditions. While some relatively small differences may be observed, or may in fact be masked, given the extent of environmental variability, pronounced differences would be observable.

91. p. 2-66: It is unclear if catch per unit effort is the same. How can a community index be calculated from the way the data were collected via a survey approach?

Response: Community indices calculations do not require the explicit input of effort or catch per unit effort. The calculation and then comparison of indices from across areas do, however, require parity in sampling gear and methods applied to assure that appropriate comparisons can be made. During the survey work care was taken to ensure that there was consistency across the different gear types (minnow traps, otter trawl sizes and net widths, gill nets and related), gear set/collection times, and the collection of field measurements (tidal cycle, water quality measurements) from the sampling locations. Therefore, the calculation and comparison of community indices for the Phase 1 data is a valid approach.

92. Hg volatilization was not observed at the site. Were measurements taken at night? Peters and Wollenberg (2006) found that fluxes could be measured at night, and were higher closer to the site and lower further away from the site.

Response: Measurement of mercury volatilization or concentrations in air was not a sampling objective in Phase 1. The proposed Phase 2 scope of work includes direct measurement of mercury in air in the breathing zone for a recreational boater throughout the BCSA (Task 7B; Geosyntec, April 2011). Measurements are not proposed at night, as recreational use is not anticipated at that time of day. In addition, volatilization is predicted to be highest during the day, as it is primarily a photochemically-dependent process.

93. Sampling season has a big influence on mercury concentration. Was this taken into account for tissue sampling?

Response: Potential seasonal variations in tissue concentrations were taken into account as part of the sampling program design for both Phase 1 and Phase 2. COPC concentrations are predicted to be highest during summer months, as observed by Weis and Ashley (2007) and other researchers in estuarine systems. Tissue sampling was conducted in June during Phase 1, and in August through early September during Phase 2.

94. p. 2-73, Section 2.8 Task 8 – Reference Site Evaluation: These five criteria don't include the most important criteria listed in the regulations. The first and most important characteristic according to the regulations is that the reference site be unaffected by contamination. If this first characteristic is not met the site should be eliminated from consideration.

Response: The Group respectfully disagrees that the reference site is required to be unaffected by contamination. USEPA guidance regarding reference site selection states "The ideal background reference area would have the same distribution of concentrations of the chemicals of concern as those which would be expected on the site if the site had never been impacted" by the CERCLA hazardous substances that are subject to investigation (USEPA, 2002). Also, please refer to the response to Comment #4 regarding reference areas.

95. p. 2-77, Section 2.8.2.1: Statistical Comparison of BCSA and Reference Area Chemical Data: Since area-weighted averages were not conducted and sampling was biased, no statistical comparisons can be made between the site and reference areas. Straight averages bias the data toward locations that had more sampling and do not provide an average that represents the area.

Response: Use of area-weighting is not an *a priori* requisite for comparative statistics. The benefit of area-weighting is dependent on a number of factors, principally the sample population data set spatial distribution, population variance of individual chemical data sets and the specific weighting approach considered (e.g., straight area-weighted or extrapolation-based). The presumption that averages may be "biased" from larger sample data sets is an oversimplification given that the representativeness of central tendency estimates are based on characterized variance within the sample population data set. For the purposes of the initial comparisons of data, the use of averages was determined to be most appropriate. The utility of both area-weighting and alternative statistical comparison approaches will continue to be considered as additional data is added as a result of Phase 2 efforts.

96. p. 2-78: Methylmercury is not a lipophilic contaminant; and should not be presented as lipid-normalized.

Response: Methyl mercury is a hydrophobic chemical, with octanol-water partition coefficients (log K_{ow}) ranging from approximately 1.7 to 2.5 (Halbach, 1985; Major et al, 1991; Faust, 1992). Relationships between percent lipid and methyl mercury concentration are not always apparent (e.g., Weis and Ashley, 2007), but moderately strong relationships have been reported in some studies (e.g., McIntyre, 2004). In some cases, percent lipids and mercury concentration may not be mechanistically related, but rather may be reflective of other factors affecting bioaccumulation/biomagnification (e.g., percent lipids may be related to fish size or trophic position, which is also related to biomagnification). Lipid normalization is one means of evaluating tissue mercury concentrations and will therefore continue to be evaluated; mercury concentrations will also be evaluated on a wet-weight basis.

97. Page 2-78, third bullet: Non-detect values should be incorporated into the dataset using the ROS method (ProUCL version 4.00.04: http://www.epa.gov/esd/tsc/software.htm). A comparison to ½ the detection limit method should be discussed in the uncertainty section.

Response: The referenced discussion on page 2-78 is related to statistical comparisons of the Phase 1 data and is not an explicit discussion related to potential exposure concentration estimation approaches (e.g., UCL). At this time the utility and appropriateness of the regression order statistics (ROS) approach is uncertain, but may be considered along with other methods (including simple substitution methods), based on the combined Phase 1 and 2 data sets. With respect to ProUCL guidance on ROS methods, Singh et al. (2006) indicated that "even though several of the substitution and ROS methods have been incorporated in ProUCL (for historical reasons and comparison purposes), those methods are not recommended by ProUCL to estimate the EPC terms or to compute other decision statistics." The utility of ROS is unresolved for environmental datasets with more than mild variance and skewness (e.g., see Singh et al., 2006; Shumway et al., 2002; Gilliom and Helsel, 1986). As additional data are added through the Phase 2 effort, use of proxy values for non-detected results will be assessed on a case-by-case basis and depending upon the intended use of the data (e.g., statistical comparisons versus exposure concentration estimations).

98. Table 2-8, Broad Street Tide Gate: The notes are incomplete.

Response: The note should state "Debris and sediment accumulation impeding proper functioning".

99. Table 2-18: There were no observations between 6/25/09 and 9/1/09. Is this a result of no field crews present or were no observations made during this period. Also, were field crews present during the evening or on weekends when working adults and children in school would likely be available to use the BCSA?

Response: Field crews were present during portions of July and August to conduct Phase 1 sampling activities, but no observations of human use were recorded during those periods. Field crews were generally present onsite until approximately 5 pm during the week, but were not present on the weekends. For these reasons, the ongoing use of cameras to monitor human use in the BCSA is a valuable means of reducing uncertainty regarding the frequency and duration of human activity.

100. Table 2-22: Many of the references used to estimate parameters such as analyte concentrations, conductivity, suspended solids, drainage area, etc. may be outdated. Reference area parameters collected for this study only should be compared to BCSA conditions.

Response: The data presented in Table 2-22 were compiled to facilitate initial reference area screening and aide in the selection of potentially suitable locations for additional evaluation. Only data collected during the Phase 1 activities were compared to BCSA conditions.

101. Table 2-24, Notes: Upper-case, bolded ***X*** *is defined, lower-case, un-bolded x is defined, but upper-case un-bolded X is not. Please define.*

Response: There was an error in the translation of this table from the original Excel file to the report table file. The lower-case un-bolded "x" and the upper case unbolded "X" represent the same condition, which is that the compound was not detected in the reference site sample, and therefore the detected concentrations at the site are assumed to be above reference site concentrations.

102. Figure 2-2: The names of water bodies, roads, etc. are double and difficult to read.

Response: Comment noted; please refer to the response to Comment #17 regarding revisions to the Phase 1 Report. Clarity of figures will be evaluated during preparation of the Phase 2 Report.

103. Figure 2-43: Please define LPRSA.

Response: The abbreviation LPRSA stands for the Lower Passaic River Study Area.

104. Figures 2-70 through 2-73: Specific reference areas were named for each segment of the BCSA. Are the comparison reference sites those most representative of each particular segment of BCSA? If so, please indicate this on the figures (i.e., UBC – reference sites: Bellman's Creek and Woodbridge River).

Response: Reference areas depicted in Figures 2-70 through 2-73 are those reference area segments that are most representative of particular BCSA segments, as determined based on physical parameters (i.e., salinity, geomorphology, vegetation, etc.). A detailed discussion of the rationale for selecting comparable study areas was presented in the Reference Area

Technical Memorandum submitted to USEPA on June 16, 2009, and available on the USEPA Deliverables project website.

Section 3

105. Page 3-1, first bullet: "Sediments in the vicinity of this tide gate were removed by others." Please define "others".

Response: Please refer to the response to Comment #44 regarding sediment removal near the West Riser Tide Gate.

106. Section 3.1, Second Paragraph, Page 3-1: Please delete the first sentence of the second paragraph.

Response: The sentence regarding improving conditions in the Meadowlands is based on a review of several documents prepared by the New Jersey Meadowlands Commission and/or its predecessor, the Hackensack Meadowlands Development Commission. Excerpts from these reports (HMDC, 1976; NJMC, 2005) are included as an attachment to this response to comments document, to provide verification of the statement in question.

107. Section 3.1, Second Paragraph, Page 3-1: Revise the third sentence since Spartina is the natural cordgrass in the Meadowlands and is the preferred habitat for aquatic and semi-aquatic species

Response: A detailed evaluation of landscape changes is proposed as part of the Phase 2 scope of work (see Phase 2 Work Plan, Task 8 – Regional Background Data Review), and will include an analysis of historic vegetation changes in the BCSA. However, based on a preliminary review of available documents and previous analyses conducted by the Group, *Spartina* does not appear to have been a historically dominant species in the BCSA. As presented in the Aerial Photograph Analysis Technical Memorandum (ELM, July 2008; available on the USEPA Deliverables Website), the dominant vegetation species in the BCSA was historically Atlantic White Cedar, a freshwater species (see attached drainage map, 1896, Figure 2). Atlantic White Cedar continued as the dominant species over a large portion of the BCSA until the 1920's when construction of the Oradell Dam and surface water diversion decreased freshwater flow in the Hackensack River, resulting in the conversion of freshwater swamp into brackish marsh, and dieback of the cedars.

The preferred salinity range for *Spartina alterniflora* is approximately 10 to 20 ppt (Landin, 1991), higher than the average salinities observed in the BCSA during Phase 1 even near the confluence with the Hackensack River (7.61 and 9.03 ppt in BCC and LBC, respectively). It is therefore unlikely that *Spartina* would have been widespread in the BCSA during the transition from cedar swamp to *Phragmites* marsh. Furthermore, review of historic aerial photography for the BCSA indicates that the study area had entirely transitioned to a *Phragmites* marsh by 1930 (see attached aerial photograph, 1930, Figure 3). Analysis of historic landscape changes in the BCSA will continue going forward and will be discussed further in the Phase 2 Report. If the agencies can provide references related to the historic dominance of *Spartina* in the BCSA, those reference will be evaluated as part of the Phase 2 analysis.

108. Section 3.1, First Bullet, Page 3-1, Second to last line: Clarify the phrase "by others" when discussing the removal of sediments by the tide gate.

Response: Please refer to the response to Comment #44 regarding sediment removal near the West Riser Tide Gate.

109. <u>Section 3.1, pg. 3.2, 1st Bullet</u> – It should be mentioned here that a significant amount of contaminated sediment was removed during the installation of the new rail line across the UOP site.

Response: The Phase 2 Report will include discussion of the sediment removal during rail line construction, as well as the additional sediment removal planned at the UOP Site. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

110. Section 3.1, Page 3-2, Third Bullet: Clarify last sentence "As part of the RI/FS work, the BCSA Group is providing assistance to MERI to extend its sediment elevation studies into the BCSA and will be monitoring the results of that ongoing study."

Response: The BCSA Group has provided a technical assistance grant to the New Jersey Meadowlands Environmental Research Institute (MERI) to facilitate installation of sediment elevation tables (SET) in the BCSA. MERI installed SETs at two locations in the BCSA in spring 2009 as part of a larger study of the Meadowlands and conducted the first round of data collection in June 2010. MERI will continue to monitor those locations and will provide data to the Group as it is available. This study will provide information regarding marsh surface elevation changes over time.

111. Page 3-3, Section 3.2: Please add a discussion describing how new information on hydrodynamics has changed the previous water budget (add specifics to each bullet, if possible).

Response: BCSA hydrology and hydrodynamics are a primary focus of Phase 2 data collection, and will be discussed in detail in the Phase 2 Report. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

112. Section 3.2.1, Page 3-4, Bullet "Tidal Prism": The Ph1 Report states that UBC is characterized by the least tidal energy and shallow water depth, and that it is predicted to support the greatest sediment deposition rates. However, Phase 1 data as presented by the PRP contradict this conclusion. For example, Figure 2-19 presents sedimentation rates as currently calculated in the report. As it can be seen in this figure, sedimentation rates in the upper reaches of the creek are lower than those of the lower reaches of the creek. (Please also refer to comments on Appendix O.)

Response: The referenced statement was intended to emphasize that the conditions (lower energy, shallow water) favor sediment deposition in UBC relative to other areas of the BCSA. However, the statement erroneously indicates that sedimentation rates are thus higher in UBC than in other areas of the BCSA. Sedimentation rates are affected by several independent factors including sediment supply. The lines of evidence being collected during Phase 2 will help to better quantify the spatial variation of sedimentation rates in the system and factors affecting them (e.g., energy, sediment supply, morphology).

113. Section 3.2.1, Page 3-5, Top Paragraph: Clarify the phase "multiple tidal cycles," since the average tidal residence time of 20 hours would imply that Upper Berry's Creek would be flushed out every two tidal cycles, or once a day.

Response: The preliminary tidal residence time calculations suggest that under average tidal conditions, approximately 2 tidal cycles are required to fully exchange water in the BCSA; while under neap tide conditions approximately 4 tidal cycles are required. These estimates will be updated in Phase 2.

114. Section 3.2.1, Page 3-5, Bullet "Flushing/Mixing": The Ph1 Report does not adequately discuss tidal resuspension. EPA agrees that "tidal action is the dominant mechanism by which water is transported through the system" (page 3-5). It is also the dominant mechanism impacting sediment resuspension and exchange with the marshes. Impacts on tidal flushing and sediment resuspension need to be included.

Response: Please refer to the response to Comment #7 regarding resuspension. Tidal flushing will continue to be evaluated as part of the Phase 2 Hydrology and Hydrodynamics sampling program. Exchange with the marshes is being evaluated as part of the Phase 2 scope of work (refer to Section 3.2.2.1 Marsh-Waterway COPC/Suspended Sediment Exchange of the revised Phase 2 Work Plan). The water budget will be discussed in further detail in the Phase 2 Report.

115. Section 3.2.2, Page 3-6: The discussion on sediment balance omitted "resuspension" as a source of solids in the water column.

Response: Please refer to the response to Comment #7 regarding the resuspension analysis in Phase 2.

116. Section 3.2.2, Page 3-7, third paragraph: Other options for characterizing sediment load transported from the risers and other tributaries, such as sediment trap sampling, should be explored. The core profiles in Appendix O do show some signs of sandy or other coarse grained sediment layers.

Response: Please refer to the response to Comment #37 regarding characterizing upland sediment inputs and the use of sediment traps. The stratigraphy and composition of the existing and proposed cores will be examined during the Phase 2 data analysis to provide additional lines of evidence on sediment sources and transport patterns.

117. Section 3.2.2, Page 3-8, Bullet "Tidal Flux": Turbidity measurements have shown poor correlation with TSS measurements thus far, so it is inappropriate to present conclusions on solids transport which are based on turbidity measurements.

Response: The Group recognizes that the relationship between turbidity and TSS is complex, and significant additional direct measurements of TSS have been added to Phase 2 to better characterize the relationship between these parameters, as discussed in the response to Comment #3. The results presented in the Phase 1 report were based on only two quarters of data, and as stated in the report, should be considered preliminary. Although the correlations were poor in the preliminary analysis, the comparison of the turbidity measurements through the system among sensors regularly calibrated to the same turbidity standards are valid comparisons. Detailed evaluation of sediment flux in the BCSA will be presented in the Phase 2 report and will incorporate data from both Phase 1 and Phase 2. The sediment flux analysis will rely on multiple lines of evidence (e.g., LISST, OBS, acoustic backscatter data, geochronology, geomorphology, etc.) in addition to the relationship between turbidity and TSS measurements. Preliminary evaluation of some Phase 2 data indicates a much improved relation (August 4, 2010 presentation to USEPA).

118. Section 3.2.2, Page 3-9, Second Full Paragraph: The text states, "A similar pattern of COPC concentrations is evident in the Phase 1 cores from marshes throughout the BCSA, which were analyzed at depth intervals of 0 to 5 cm and 10 to 15 cm." Note that Weis et al. (2005) collected and analyzed continuous high-resolution sediment cores with intervals ranging from 1 cm to 2cm. The Phase 1 marsh samples analyzed two intervals from a discontinuous core with 5 cm intervals. Consequently, it is not appropriate to state that similar contaminant concentrations as Weis et al. (2005) were observed. It can only be stated that the Phase 1 *marsh data are consistent with the Weis et al. (2005) study, where deeper sediment depths are more contaminated than surface sediments.*

Response: Agreed. The Phase 1 data are consistent with the Weis (2005) study.

119. Section 3.2.2, Page 3-10: In footnote 21, dry bulk density of the sediment was assumed 0.5 g/L. However, in the text a calculation of dry bulk density was 0.19 g/cm^3. Please confirm units/terminology.

Response: The value of 0.5 g/L cited in the footnote is incorrect. The correct value of 0.19 g/cm^3 was applied to develop the cited estimate of 1.59 million kg of inorganic sediment deposition from 1963 to 2002.

120. p. 3-11: Sediment load from uplands runoff is estimated at 59 million kg, apparently based on the NURP values from p. 3-7 taking the current urban runoff value and multiplying it over 39 years. However, the conditions in the past were not necessarily the same as today, particularly the NJSEA which is excluded from the load calculations on p. 3-7 because it now drains to a settling pond. Might it have been a more significant load in the past? Same with CSOs: hopefully there are some BMPs now that were not in place in 1963? If runoff loads were greater in the past, then that would leave a smaller load to be assigned to tidal input from downstream. It also might mean lower present sedimentation rates. In general, caution must be used when extrapolating across significantly different time periods, and the uncertainties raised by that extrapolation should be discussed.

Response: The Group concurs that sediment loading from uplands runoff changed over time in response to changes in the BCSA watershed. Historical changes to the BCSA watershed and Hackensack Meadowlands that may have influenced sediment supply, transport, and deposition, including construction of the NJSEA facility, will be further evaluated as part of the Phase 2 investigation (Task 8 – Regional Background Data Review). These factors will be considered in future analyses of the BCSA sediment dynamics.

121. The report notes "This analysis is consistent with the CSM… which indicates that the Hackensack River is the primary source of sediments to the system." Rather than discussing whether two conceptual models are consistent with one another, whether they are consistent with empirical evidence should be discussed. This analysis indicates that the Hackensack is the source of about 50% of the sediment in Berry's Creek, but is that number changing with time? Going forward, the Phase 2 Work Plan described here will address some of these concerns, but #3 should include not only the contemporary sediment balance but the historical movement of sediment. The historic release of contamination from the BCSA to the Hackensack River should be evaluated to help understand current contaminant transport.

Response: The Group concurs that additional empirical evidence is required to evaluate the CSM for sediment transport in the BCSA, and will continue to evaluate factors influencing sediment flux going forward. Collection of data required to characterize sediment sources and sinks in the BCSA is a primary focus of the Phase 2 investigation, and the Phase 2 Report will present a detailed analysis incorporating both Phase 1 and Phase 2 data. Factors influencing historic sediment transport in the BCSA will be considered with respect to interpretation of sediment core data (i.e., geochronology and COPCs), and to the extent they are relevant, to current and future sediment and COPC transport. In addition, a chronology of factors that have changed the hydrology and sedimentology of the BCSA is being prepared as part of the Phase 2 work.

122. Section 3.3.4.2, pg. 3-20 – The FDA standards and other human health criteria for fish consumption should be included in the discussion of fish tissue results in this section and throughout the report.

Response: This section of the Phase 1 Report was intended to summarize concentration patterns of key site COPCs, and not to provide information relative to the risks posed by these same compounds, and therefore risk-based concentration standards were not presented. Future discussion of the risk significance of measured residue levels will utilize site-specific standards. Because FDA action levels are applicable to chemical concentrations in products within the commercial market, they are not directly applicable to an evaluation of chemical concentration data for site fish and crab.

123. Section 3.4, Page 3-21: The discussion regarding preliminary identification of potential sources should include a discussion of known Superfund sites in the area.

Response: Please refer to the response to Comment #2, regarding potential sources in the BCSA.

124. p. 3-24, Section 3.4.3, Hackensack River: The Hackensack River receives discharges from the BCSA and fish collected in that region have elevated Hg concentrations. Hg concentrations in deeper sediments near the Hackensack River increase with depth similar to the pattern observed near the source of the Hg. Discussion of the Hackensack River data being compiled into regional "background" data set should acknowledge that the contamination in the Hackensack River could be directly related to releases from within BCSA.

Response: The Phase 2 scope includes an evaluation of regional background sediment concentrations, including data from the Hackensack River. The distribution of mercury concentrations will be evaluated in relation to potential sources, which are distributed along the Hackensack River estuary. These data will be thoroughly discussed in the Phase 2 report.

125. Page 3-24: Both the Groundwater and Hackensack River sections are numbered 3.4.3. Please revise.

Response: Comment noted; please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

126. Figure 3-25: Clarification should be provided for what is meant by the footnote 1: tidal prism [vol] is 40 to 5,000 times greater than groundwater discharge [vol/time]. Is this referring to the volume of the tidal prism over a single tidal cycle?

Response: The tidal prism volume (i.e., the amount of tidal exchange per 12.4-hr tidal cycle) is 40 to 5,000 times greater than the volume of groundwater estimated to discharge to the BCSA over the same 12.4-hr period.

127. Section 3.5.1, Page 3-26: The report states, "Mercury concentrations in sediment have generally attenuated in all horizons across the recent decades, as have surface water concentrations. These findings indicate the primary sources of mercury have been controlled or substantially reduced." This type of statement seems to try to diminish the potential risk from the site, and does not acknowledge that there are still significantly elevated levels of mercury in surface sediment.

Response: The Group acknowledges that COPC concentrations in surface sediments exceed screening criteria at many locations throughout the BCSA (see Section 2.3.3 and Appendix G of the Phase 1 Report), and the referenced text does not suggest otherwise. Analysis of potential human and ecological risk is ongoing, and will be discussed in more detail in the Baseline Ecological Risk Assessment (BERA) and the HHRA.

128. Section 3.5.1, Page 3-26, First bullet: Is it correct to state that mercury concentrations have attenuated in all horizons, including the deeper sediment horizons corresponding to the periods of largest contaminant release? The statements regarding attenuation of contaminants in Berry's Creek do not have sufficient context in terms of likely current deposition rates and projected recovery timeframes to useful for site decision making. These conclusions, which appear throughout the report, should be qualified in each instance to reflect the associated uncertainties in the data set and interpretations. According to USEPA's Contaminated Sediment Remediation Guidance, lines of evidence to support natural recovery should also include demonstrated trends of decreases in biota contaminant levels, water column concentrations, and BAZ sediment concentrations.

Response: The BCSA Group agrees that the RI data will need to be evaluated with regard to the lines of evidence to support natural recovery. Discussion of COPC patterns and apparent attenuation trends in the Phase 2 Report will be done with more specificity and clarity.

129. Section 3.5.1, Page 3-26: The two bullets should be revised. While relatively lower mercury and PCB Aroclor concentrations are observed in surface sediments than sub-surface sediments (at some locations), surface sediment concentrations still exceed guidance values and pose a potential human health and ecological risk.

Response: Please refer to the response to Comment #17 regarding Phase 1 Report revisions, and Comment #127 regarding ongoing evaluation of sediment COPC concentrations and risk.

130. p. 3-27, last bullet: The report notes "Mid-1900s" can be interpreted as ca. 1905 and ca. 1950. This needs to be clarified. From the context within the rest of the document it's presumably the latter?

Response: Please refer to the response Comment #23.

131. p. 3-29, Section 3.6.1, COPC Screening: The report states benchmarks were compiled for all chemical detected in sediments, surface water and biota. Benchmarks for both human and ecological receptors were compiled and the lower of the benchmarks was used as the screening value to support identification of COPCs, recognizing that these benchmarks are highly conservative and particularly so when applied to a highly urbanized system such as the BCSA. This statement appears to contradict what was said on page 3-30 regarding the sediment screening benchmarks selected being not the most conservative.

Response: The benchmarks selected were the most conservative benchmarks available of those determined to be relevant to the site. The benchmarks selected for sediment are from the upper end of the NJDEP screening benchmarks, but nevertheless are considered screening benchmarks by NJDEP. The upper end values were selected because the low end of the of the values was not considered relevant for COPCs screening in an urbanized and industrialized waterway such as the BCSA, in which the cumulative impacts of historical regional urbanization and development has led to a decreased sediment quality. The selection of the upper end of the values to screen for ecological risk is consistent with NJDEP guidance which allows for consideration of site-specific conditions in the application of their screening benchmarks.

132. Page 3-29, Surface Water: "FW2 criteria for human health were not used as these values are applicable to waters that can support a public potable water supply. Because the freshwater portions of the BCSA are subject to periodic high salinity events (up to 8 ppt), they *are precluded from consumptive use, and human health-based FW2 criteria were not appropriate." According to the NJDEP Surface Water Quality Standards, "Fresh water(s)" means all nontidal and tidal waters generally having a salinity, due to natural sources, of less than or equal to 3.5 parts per thousand at mean high tide. At low tide, the salinity may be periodically higher. FW2 waters are not the most pristine freshwaters and do not have exceptional water supply significance as do FW1 waters. In the SWQS, it defines the entire length of Berry's Creek as FW2-NT/SE. The ARARs should be applied.*

Response: The classification is in fact, both freshwater (FW2-NT) and saline (SE). Given the dual classification, we used the salinity and NJDEP regulations to define freshwater as those waters with salinity below 3.5 ppt. No portion of Berry's Creek sampled during Phase 1 was consistently below that salinity level and therefore the saline/estuarine classification is applicable to Berry's Creek. Data collected prior to Phase 1 indicated freshwater conditions in UBC but the higher than normal tides the last couple of years appears to have increased the average salinity above the freshwater threshold.

133. Page 3-30, first bullet: "If no NJSWQS was available, federal water quality standards for the protection of aquatic life or human health were used." The most stringent of the water quality standards should be used.

Response: NJSWQS are the surface water standards applicable to New Jersey waters and therefore were used. In most cases, the NJSWQS values were comparable to federal standards.

134. Page 3-30, Fish/Crab Tissue, second bullet: "ORNL provides a data base of human health-based screening benchmarks for the protection of human health for the fish consumption exposure pathway. The lower of the non-cancer and cancer-based screening benchmarks was considered for use in the COPC screening." The EPA RSL table does not address fish tissue. There is a link from EPA Region 3 for fish tissue screening values that may be used: http://www.epa.gov/reg3hwmd/risk/human/pdf/DECEMBER_2009_FISH.pdf.

Response: The draft report should have stated more explicitly that the USEPA calculator tool (that was available through the ORNL website at the time the draft Phase 1 report was being prepared) was used to develop the screening levels.

135. Page 3-30, last paragraph: "Screening benchmarks were not available for some chemicals. In these cases, if a benchmark was available for a chemical that was considered a reasonable surrogate (e.g., based on similarities in chemical structure), the benchmark for the surrogate was used for the chemical to support the COPC screening effort." Currently, EPA does not have an approved method for selection of surrogates. If a contaminant is suspected to be driving risk and no screening benchmarks are available to quantitatively evaluate the risk, *please retain the contaminant and add language in the risk characterization and uncertainty sections discussing the degree to which risk is likely underestimated, if possible.*

Response: None of the compounds without published screening criteria are expected to be driving risk at the site. Nevertheless, the final baseline risk assessments will note which compounds do not have screening or toxicity criteria and discuss the implications in the risk characterization and uncertainty sections. The Phase 2 sampling includes a subset of samples to be analyzed for all target analyte list/target compound list (TAL/TCL) analytes, regardless of the availability of benchmarks.

136. Page 3-31, first paragraph: "A few analytes have no published benchmarks and no reasonable surrogate. With the exception of methyl mercury, chemicals without screening benchmarks are not evaluated further." If there is no benchmark, the compound should be retained and a statement should be included in the risk characterization and uncertainty sections to explain that the risks may be underestimated because there was no toxicity value for compound(s) x (y, z, etc.). Depending on the concentration of the contaminants, a degree of uncertainty may be estimated.

Response: Compounds without benchmarks will be discussed in the risk characterization and uncertainty sections of the baseline risk reports. The Phase 2 sampling includes a subset of samples to be analyzed for all TAL/TCL analytes, regardless of the availability of benchmarks.

137. Page 3-31, second paragraph: Please indicate that any known human carcinogens were retained as COPCs, regardless of frequency.

Response: The chemicals exceeding screening benchmarks, but removed due to a low detection frequency (<5%) were: thallium (tissue – LBC), 3,3'-dichlorobenzidine (sediment – LBC, UBC), 2,4'-DNT (sediment – UBC), 2,6'-DNT (sediment – LBC, MBC), and PCB-1268 (sediment – UBC). None of these constituents is a Class A Human Carcinogen. Some Class A carcinogens were detected infrequently at the site but not present above benchmarks (e.g., benzene in sediment) and therefore were not selected as COPCs. Nevertheless, the Phase 2 investigation includes a subset of samples for all TAL/TCL chemicals.

138. Page 3-31, third paragraph: "...the maximum detected concentration of each chemical was compared against media-specific screening benchmarks on a BCSA-reach-specific basis. For surface water, dissolved metal concentrations were used." Please explain how the media-specific benchmarks were derived. To remain conservative, total metal concentrations should be used.

Response: Media-specific benchmarks were derived from published sources. New Jersey-specific values were used if available. The text provides the discussion of the source of values and the derivation of values for chemicals with no benchmarks.

The Group agrees that the most conservative approach is to compare surface water benchmarks to total measured concentrations. As noted in the response to Comment #69, subsequent evaluations of surface water data will consider dissolved and total concentrations, as appropriate. The aquatic life NJSWQS for metals, for example, are explicitly expressed as a dissolved criteria, and therefore, comparisons to total concentrations are not consistent with the intent of the criteria. The saline waters human health NJSWQS were developed to protect humans from consumption of fish (not water), and therefore, comparison to dissolved chemical concentrations (which best represents the bioavailable fraction for uptake) was deemed appropriate. Future risk evaluations will utilize either dissolved or total concentrations depending upon the exposure scenario being evaluated.

139. Page 3-32, first paragraph: "…though they will be included for analysis in a subset of ~~chemicals~~ samples."

Response: Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report.

140. Page 3-32, second paragraph: "In applying USEPA's contaminated sediment management principles to COPC selection for the BCSA, only chemicals that were frequently detected (>5 percent) and at concentrations that were above risk-based benchmarks were considered. Chemicals that met each of these criteria in each of the three samples media were selected as primary COPCs for the BCSA. Chemicals that met these criteria in two media were considered for inclusion as secondary COPCs." It does not appear to serve a purpose to categorize COPCs as primary or secondary in this manner, but rather on concentrations and frequency of detection.

Response: Both primary and secondary COPCs are detected frequently and at elevated concentrations relative to risk-based standards. The Group recognizes that the terms "*primary*" and *"secondary"* are a nuanced characterization that describes the prevalence of these compounds across media, and may not be critically important in defining site conditions. In any event, both primary and secondary COPCs are included in the Phase 2 analyses.

141. p. 3-32: The report states, "In applying USEPA's contaminated sediment management principles to COPC selection for the BCSA, only chemicals that were frequently detected (>5 percent) and at concentrations that were above risk-based benchmarks were considered. Chemicals that met these criteria in each of the three sampled media were selected as primary

COPCs for the BCSA. Chemicals that met these criteria in two media were considered for inclusion as secondary COPCs." Given the high screening criteria and the fact that some chemicals will partition mainly to one media, chemicals that met criteria in only one media should also be retained as COPCs. Pesticides should also be retained as COPCs, they are widespread in many places so should not be eliminated based on that fact. Their origin may be uncertain however, they may contribute to risk in this area and need to be retained to help with risk interpretation.

The fourth paragraph notes that, "…a number of metals…were also present in surface water above benchmarks and background." It is unclear what is meant by background or why data are being screened against "reference" or "background" this early in the risk assessment process (also as shown in Table 3-7).

Response: The primary purpose of the COPC screening presented in the Draft Report was to provide some rationale to focus 1) the data discussions presented in the Phase 1 Report on a subset of detected chemicals and also 2) the subsequent sampling to be conducted in Phase 2 on key, risk-driving chemicals. The Group is confident that the approach used has identified the key risk driving chemicals that ultimately will be the focus of sediment management strategy developed for the site. Nevertheless, the Phase 2 investigation includes a subset of samples to be analyzed for all TAL/TCL compounds (including pesticides; see response to General Comment #3 on the Phase 2 Work Plan [July 27, 2010 letter to Doug Tomchuk) and these additional compounds will be considered in the baseline risk assessments to be conducted for the site.

The term background, as used in the Phase 1 report, refers to the reference sites that were selected to represent the conditions at the BCSA except for the BCSA-specific release of CERCLA substances. Previous communications with USEPA have provided the rationale and overall support for the selection of these sites as representative reference sites for the BCSA, which will be augmented in Phase 2 with a regional background evaluation.

142. Section 3.7.1, Page 3-34 and Figure 3-20: Figure 3-20 is referenced in the text but not described. A brief discussion on bathymetry should be provided. Moreover, the surface elevations depicted in the figure are not legible. The bathymetric data should be presented in a series of figures with an adequate zoom level.

Response: Figure 3-20 depicts channel sediment elevations throughout the BCSA, based on the results of detailed bathymetric and geophysical surveys conducted in 2008. Although the data are presented at a large scale that does not allow for detailed interpretations, the figure clearly illustrates the deepest areas (in turquoise; e.g., BCC, meander bends) and the shallowest areas (in purple; e.g., upper LBC, UBC) of the BCSA. Please refer to the response to Comment #35 for additional information regarding bathymetry data.

143. p.3-38, 2nd bullet: The report states, "Phase 1 biota sampling demonstrates that the total mercury present in animal tissue was at concentrations below those reported in BCSA sediments and is not substantially elevated above reference areas." This statement highlights the importance of using appropriate reference areas, that is, ones unaffected by site related contaminants.

Response: See response to Comment #4.

144. p. 3-40: The report notes the BAZ was estimated to be 6 cm in depth in UBC and 10 cm in depth in the other reaches. It would be useful to re-visit the work the SPI work that was previously conducted to ensure that the methodology used to establish these depths is still appropriate prior to any additional sampling. See additional comments on Appendix C below.

Response: The BCSA Group will continue to conduct an integrated analysis of the different types of sediment data, including the SPI work, as more data are collected as part of Phase 2.

145. Page 3-40, Section 3.7.4: Please update this section to include exposure scenarios and assumptions that have been updated by EPA in the recent comment document.

Response: This section of the Phase 1 report did reflect agreed upon changes to the human exposure pathways. Subsequent risk assessment deliverables will also reflect those agreements.

146. Page 3-40, Section 3.7.4, second bullet: Exposure frequencies will be based on the default. Utility of the camera study will be determined by EPA.

Response: Please refer to the responses to Comments #21 and #87 regarding the camera study.

147. Page 3-43: Phase I Characterization results should be re-evaluated with the inclusion of additional exposure pathways.

Response: The Pathway Analysis Report (PAR) submitted to USEPA includes an evaluation of the Phase 1 data in light of the agreed upon exposure pathways.

148. Section 3.10, pg. 3-44 - Similar to the sediment removal at the West Riser Ditch, contaminated sediments were excavated during the rail line installation across UOP. This should be included in this section.

Response: Please refer to the response to Comment #109 regarding sediment removal during rail line installation.

149. *Table 3-2: Screen against NJDEP SWQS FW2 for human health if this value is the lowest of the screening values.*

Response: As mentioned in response to Comment #132, Berry's Creek has a dual classification as both freshwater (FW2-NT) and saline (SE). Given the dual classification, we used the salinity and NJDEP regulations to define freshwater as those waters with salinity below 3.5 ppt. No portion of Berry's Creek sampled during Phase 1 was consistently below that salinity level and therefore the saline/estuarine classification is applicable to Berry's Creek. Additionally, as stated in the Phase 1 Report, the natural conditions in this waterway are such that it could not serve as a permanent source of potable water. Therefore, the Group maintains that the use of the saline water standards for the protection of human health is appropriate.

150. *Table 3-4: A number of the detected analytes without screening benchmarks can be screened against EPA 2009 RSL values for residential soil.*

Response: The exposure assumptions used to calculate benchmarks for chemicals in residential soil are not applicable to potential exposures in humans contacting Berry's Creek sediment during occasional recreational use. Therefore residential soil benchmarks are not sufficiently site-specific to be useful in the Berry's Creek assessment. Several of these chemicals are nutrients (e.g., calcium, magnesium), some were detected only in a single site medium (e.g., several SVOCs), and overall, none are likely to contribute importantly to risk or management decisions at the Site.

151. *Figures 3-5 and 3-6: It is difficult to see the depurated and whole body results, respectively. Perhaps choose a different color.*

Response: Comment noted; please refer to the response to Comment #17 regarding revisions to the Phase 1 Report. Clarity of figures will be evaluated during preparation of the Phase 2 Report.

152. *<u>Figures 3-7, 3-8 and 3-9</u> – Please include the FDA standards for fish consumption on these figures.*

Response: Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report and the response to Comment #122 regarding comparison of tissue residues to FDA standards.

153. Figure 3-20: Is there a 10 meter difference in elevations between the upstream and downstream sections as shown?

Response: There is an approximately 7 meter difference in channel elevations between the confluence of BCC (approx. -22 feet msl) and the shallowest portions of UBC (approx. -0.5 feet msl). The higher elevations depicted in the color scale are present along the edges of the channel and reflect the elevations at the transition to the adjacent marsh or upland. Please refer to response to Comment #35 for additional information regarding bathymetry data.

<u>Section 4</u>

154. Page 4-9, (USEPA, 1992e): Please complete reference

Response: The incomplete reference was incorrectly included in the list of citations. Only documents USEPA 1992a through 1992d are referenced in the text.

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LEGEND

- Berry's Creek Study Area (BCSA) Boundary
- 16 General Notice Letter (GNL) Recipient and ID Number
- 1 Superfund Site Location and ID Number
- 1 New Jersey Pollutant Discharge Elimination System Location (NJPDES) and ID Number
- 1 NJDEP Known Contaminated Site Location (KCS) and ID Number
- Former Sewage Treatment Plant (STP) Location (Approx)
- Outfalls Observed During Phase I

GNL Sites

LABEL ID	SITE NAME
4	Bendix Defense Plant
14	Greif Brothers 1
15	Greif Brothers 2
16	Haarman & Reimer/Florasynth
26	Port Authority of NY & NJ
29	Reckitt Benckiser/Teterboro
41	Sun Chemical 3
42	United Wire hanger Corp.
48	Wella Corp

NJDEP 2009 NJPDES DSW Sites

LABEL ID	NJPDES ID	FACILITY NAME
13	NJ0033553.001A	Kohl & Madden
14	NJ0033669.001A	Takasago Corp USA
15	NJ0035246.001A	Wella Corp
16	NJ0035246.002A	Wella Corp
17	NJ0035246.003A	Wella Corp
18	NJ0052540.001A	United Wire Hanger Corp
19	NJ0052540.002A	United Wire Hanger Corp
20	NJ0103128.001A	Sumitomo Machinery Corp
24	NJG0028941.001A	Teterboro Airport Johnson Controls
25	NJG0028941.002A	Teterboro Airport Johnson Controls
26	NJG0031194.001A	Atlantic Aviation Corp
27	NJG0055719.001A	Teterboro Airport
28	NJG0102733.001A	Merit S/S - Merit Oil of NJ
35	NJG0140236.001D	Getty S/S 56899
37	NJG0147231.001E	Greif Bros Corp
39	NJG0163902.001A	7-Eleven 27479 (former)

NJDEP 2009 Known Contaminated Sites:

LABEL ID	NJDEP ID	SITE NAME	LABEL ID	NJDEP ID	SITE NAME
1	3114	GREIF BROS CORP	87	5646	CANADA DRY OF NY BOTTLING CO
2	9535	THE WELLA CORP	88	5915	STRANAHAN FOIL
3	32017	POTDEVIN MACHINE CO	93	4365	A & E STORES TETERBORO AIRPORT
4	22867	SYMRISE INC	94	3234	SHELL SERVICE STATION 3225 0206
5	19866	AT&T WIRELESS SEVICES INC	95	3266	PEPSI-COLA BOTTLING GROUP
6	23095	SUMITOMO MACHINERY CORP	96	5730	BUITONI FOODS CORP
7	2071	AEROIL PRODUCTS COMPANY INC	101	19868	MOONACHIE ROAD PUMP STATION
8	6473	NATUREX INC	105	31865	TEXACO REFINING & MARKETING INC
19	4700	SHELL SERVICE STATION 138373	121	31971	SEMINARA CONSTRUCTION
20	3496	SHELL STATION 116793	122	32255	BABEK COMMERCIAL TIRE SERVICE
21	1629	GETTY 56899	125	96970	NEWCAL AVIATION
22	8141	EXXON R/S 35629	129	G000001190	FORD FASTENERS INCORPORATED
23	7800	EXXON R/S 35630	134	G000004547	VENTRON VELSICOL
24	10220	HASBROUCK HEIGHTS CITGO	135	G000009791	11 ROMANELLI AVENUE
25	9116	MERIT HASBROUCK	140	G000029533	LYNDHURST COAT INCORPORATED
26	33729	MERCURY FOAM CORP	143	G000033390	CARDINO REALITY COMPANY
27	7837	EXXON R/S 32505	144	G000033750	BOROUGH OF TETERBORO
28	33623	ACME AUTOMOTIVE INC	146	G000034525	CATENA WHOLESALE PROPERTY
29	G000062639	CAPORALE ENGRAVING COMPANY INCORPORATED	147	G000035601	SIGNATURE FLIGHT SUPPORT CORPORATION
44	5851	HONEYWELL INTERNATIONAL INC	151	G000033577	CARPENTER SHOP
54	19678	SPARTECH POLYCAST INC	152	G000061415	CULVERT UNDER ROADWAY
55	1049	MALCOLN AVENUE FUEL FARM	155	G000007543	UNILUX INCORPORATED
60	13693	GENERAL DIAPER SERVICE	157	11005	HASBROUCK HEIGHTS DEPT OF PUBLIC WORKS
61	2070	SPINNERIN DYE CO INC	161	239896	39 INDUSTRIAL AVENUE
63	25555	162 LODI ST	163	282181	TEXACO SERVICE STATION #27479
64	262871	OCCO SPECIALITIES INC	164	290409	BRD CORP
68	21831	FIRST AVIATION SERVICES INC	166	465395	W&H REALTY
71	1531	TOWN SUNOCO	169	421418	BERGEN FIRE EQUIPMENT CO INC
85	3391	RICHEN CO	171	456357	329 ROUTE 17 S ABANDONED CONTAINER

NOTES:
1. This map was created, in part, using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.
2. Some sites have multiple designations (e.g., Superfund site and GNL site).
3. The origin and contribution of non-point sources of hazardous substances is not indicated on the figure.

SOURCE:
1. NJPDES Locations, NJDEP GIS Digital Data, 2009
2. NJDEP KCS, NJDEP GIS Digital Data, 2009
3. GNL Sites, FTI Consulting, March 2011
4. Former STP, NJDOH 1930 and BSAWA 1983
5. Observed Outfall Locations, Geosyntec, 2010
6. Microsoft Virtual Earth World Imagery, Microsoft Corp., 2009

N

0 800 1,600

SCALE: 1 " = 800 '

TITLE: FIGURE 1A
APPROXIMATE LOCATIONS OF IDENTIFIED CONTAMINATED SITES
AND POTENTIAL PAST OR CURRENT DISCHARGES
IN THE BCSA, NORTH OF MOONACHIE AVENUE

LOCATION:
BERRY'S CREEK STUDY AREA
BERGEN COUNTY, NEW JERSEY

DATE: 7/50/2011

FILENAME: KCS_NPDES_Non_Tidal_final.mxd

THE ELM GROUP
218 WALL STREET, PRINCETON, NEW JERSEY 08540
4920 YORK ROAD, SUITE 290, HOLICONG, PENNSYLVANIA 18928
612 MAIN STREET, BOONTON, NEW JERSEY 07005
267 BROADWAY, FIFTH FLOOR, NEW YORK, NEW YORK 10007
2475 BAGLYOS CIRCLE, BETHLEHEM, PENNSYLVANIA 18020
www.exploreELM.com

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LEGEND

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- Former Sewage Treatment Plant (STP) Location (Approximate)
- Outfalls Observed During Phase I
- Historic Landfill/Dump Site (Approximate)

GNL Sites

LABEL ID	SITE NAME	LABEL ID	SITE NAME
33	Scapa, f/k/a Finite Industries	23	National Die and Button Mould
27	President Container, Inc	38	Sterling-Regal Inc.
25	NY Times	34	Scientific Design Company Inc.
30	Revlon, aka C&E Laboratories	12	General Foam/Carlstadt
7	Burroughs Corp	31	RJR Archer, Inc
37	Stanbee Company, Inc.	1	BASF (Arsynco Site 61-69)
8	Cellofilm	35	SCP
49	Yoo-Hoo Chocolate	28	Reckitt Benckiser/Carlstadt
9	Compo Indu of New Jersey	44	Ventron/Velsicol
6	Brevel Motors, Inc.	19	Henkel/Diamond Shamrock
18	Hartin Paint and Filler	10	Cosan Chemical
17	Halcon Catalyst Industries		

NJDEP 2009 NJPDES DSW Sites

LABEL ID	NJPDES ID	FACILITY NAME
5	NJ0002798.001A	Henkel Corporation
6	NJ0003344.001A	Yoo-Hoo Beverage Co
8	NJ0005754.001A	Technical Oil Products Co Inc
10	NJ0032522.001A	Cosan Chemical Corp
11	NJ0032522.002A	Cosan Chemical Corp
12	NJ0032590.001A	Spear Packing Corp
25	NJG0028941.002A	Teterboro Airport Johnson Controls
29	NJG0106640.001A	Roadway Express Inc
30	NJG0106640.002A	Roadway Express Inc
31	NJG0106640.003A	Roadway Express Inc
32	NJG0106640.004A	Roadway Express Inc
33	NJG0106640.005A	Roadway Express Inc
34	NJG0127973.001A	Sunoco S/S

NJDEP 2009 Known Contaminated Sites

LABEL ID	SITE NUMBER	SITE NAME	LABEL ID	SITE NUMBER	SITE NAME
16	31785	TECHBESTOS INC	76	237946	ALUMINUM ANODIZING INC
17	2679	A E&A SERVICE STATION INC	77	2571	CON-WAY CENTRAL EXPRESS
18	10621	UPS FREIGHT	80	601	YRC INC
37	22991	SEDEVER INC	84	1946	745 ASSOCIATES
38	G000003390	ELECTROMEK COMPANY	86	4668	FLEET MAINTENANCE SERVICES INC
39	7271	MARTIN PICARD/VERFLEX	89	7895	TERMINAL CONSTRUCTION CORP
40	G000062622	PIONEER PAPER CORP	91	12075	C&C EXPRESS INC
41	2517	RYDER TRANSPORTATION SERVICES 0842	100	15054	DIAMOND SHAMROCK CHEMICALS CO
43	21507	ARTECH INTERNATIONAL INC	102	19870	CAESAR PALACE PUMP STATION
46	5916	ANDY SON INC	103	24248	ARSYNCO INCORPORATED
47	G000001257	FRED HEINZELMAN & SONS INCORPORATED	104	24657	A BOHRER INCORPORATED
48	11126	TUNNEL BARREL & DRUM CO INC	106	13220	MEADOWLANDS SERV & PARTS CTR
49	G000004165	APPLIED PRINTING TECHNOLOGIES, L.P.	107	16123	PHOTOGRAVURE & COLOR COMPANY
50	113	WOOD-RIDGE BORO DPW	112	18839	RJF GRAPHICS
51	G000001197	ELCO SOLVENTS CORPORATION	114	22500	AGA ASSOCIATES
52	132990	RANDOLPH PRODUCTS CO	117	25566	RANDOLPH PRODUCTS CO
53	5094	GENERAL VY COAT LLC	118	26351	JAKE & TOMS MEADOWLAND SERVICE
56	32777	CARRETTA TRUCKING	131	G000003575	SCIENTIFIC CHEMICAL PROCESSING INC
58	2953	TECHNICAL OIL PRODUCTS INC	134	G000004547	VENTRON VELSICOL
59	20781	COSAN CHEMICAL CORPORATION	137	G000021769	329 HACKENSACK STEET
62	3970	KNICKERBOCKER BED CO	139	G000029309	STARKE ROAD
67	G000006796	SCIENTIFIC DESIGN CO INC	141	167222	SEAGRAVE COATINGS CORP
69	189762	BOBKER BEARINGS INCORPORATED	142	G000003981	WATER JEL TECHNOLOGIES
72	G000035895	INFINITI COLOR GRAPHICS INCORPORATED	156	172170	SUPERIOR PRINTING INKS
73	12880	CONSOLIDATED FREIGHTWAYS	168	9424	YELLOW TRANSPORTATION INC (CNJ)
75	G000015829	MEADOWLANDS BINDERY INCORPORATED			

NOTES:
1. This map was created, in part, using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.
2. Some sites have multiple designations (e.g., Superfund site and GNL site).
3. The origin and contribution of non-point sources of hazardous substances is not indicated on the figure.

SOURCE:
1. NJPDES Locations, NJDEP GIS Digital Data, 2009
2. NJDEP KCS, NJDEP GIS Digital Data, 2009
3. GNL Sites, FTI Consulting, March 2011
4. Former STP, NJDOH 1930 and BSAWA 1983
5. Observed Outfall Locations, Geosyntec, 2010
6. Historic Landfill/Dump Sites, LECG, 2010
7. Microsoft Virtual Earth World Imagery, Microsoft Corp., 2009

0 500 1,000

SCALE: 1 " = 500 '

TITLE:

FIGURE 1B

APPROXIMATE LOCATIONS OF IDENTIFIED CONTAMINATED SITES AND POTENTIAL PAST OR CURRENT DISCHARGES IN THE BCSA, BETWEEN PATERSON PLANK ROAD AND MOONACHIE AVENUE

LOCATION:

BERRY'S CREEK STUDY AREA
BERGEN COUNTY, NEW JERSEY

DATE: 7/5/2011

FILENAME: KCS_NPDES_UBC_final.mxd

THE ELM GROUP
218 WALL STREET, PRINCETON, NEW JERSEY 08540
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LEGEND

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- Former Sewage Treatment Plant (STP) Location (Approximate)
- Historic Landfill/Dump Sites (Approximate)
- Outfalls Observed During Phase I

GNL Sites

LABEL ID	SITE NAME	LABEL ID	SITE NAME
2	Becton Dickinson	22	Matheson Tri-Gas, Inc.
3	Bell Container Corp	24	New Jersey Sports and Exps Aut
5	Berlin and Jones Co., Inc.	32	Scancelli Prints
11	DuBois Chemicals	36	Sequa Corporation
13	General Foam/East Rutherford	39	Sun Chemical 1
20	Howmedica Inc	40	Sun Chemical 2
21	Insulfab Plastics, Inc.	43	UOP (Honeywell)

NJDEP 2009 NJPDES Sites

LABEL ID	NJPDESID	FACILITY NAME
1	NJ0001074.001A	Becton-Dickerson Company
4	NJ0002721.001A	Matheson Gas Products Inc
9	NJ0030970.001A	Arsynco Inc
21	NJ0167037.001A	Universal Oil Products
22	NJG0003646.001A	US Ink - Div Of Sun Chem
23	NJG0023345.001A	NJ Sports & Exposition Authority
36	NJG0145866.001A	Orchard Square
38	NJG0157210.004A	AB Office Meadowlands Mack Cali LP
40	NJG0167665.001A	Meadowlands Sports Complex
41	NJG0167665.002A	Meadowlands Sports Complex
42	NJG0167665.003A	Meadowlands Sports Complex

NJDEP 2009 Known Contaminated Sites

LABEL ID	SITE NUMBER	SITE NAME	LABEL ID	SITE NUMBER	SITE NAME
116	24991	GENERAL TIRE OF NJ	158	197966	62 RAILROAD AVENUE
9	6294	LUKOIL #57266	70	24376	SHUSHANA CO
34	9534	MEADOWLAND TRUCK STOP INC	148	G000037573	71 E UNION AVENUE
150	G000044710	185 RTE 17 S	92	550	BTF CORP
113	19916	BOILING SPRINGS SERVICE STATION	126	92085	FOREST DAIRY
65	30463	AMBIX LABORATORIES	14	1398	DELTA
79	31490	EAST RUTHERFORD FORMER COAL GAS PSE&G	99	11589	EAST RUTHERFORD DPW
159	208638	NJDOT ROUTE 17 DRAINAGE	98	10800	TNT INC
132	G000003805	DUBOIS CHEMICALS	57	280789	HOWMEDICA INC ORTHOPEDICS DIV
170	424372	WILZIG ASSOCIATES LLC	124	90133	RUTHERFORD TARRAGON DEVELOPMENT 1
11	13905	HOWMEDICA INC	66	32652	BELLAVIA CHEVROLET-GEO-BUICK
149	G000042223	C RAIMONODO & SONS CONSTRUCTION	133	G000004427	MADISON CIRCLE
31	6121	SCANCELLI PRINTS INC	42	G000001108	WESTMOUNT TOOL CORPORATION
13	468410	UNION CLEANERS	160	90361	GFM DEVELOPMENT INC
145	G000033967	DUBOIS STREET	12	568	EXXON 3-9784
136	G000021584	55 MADISON CIRCLE DRIVE I F O	90	9076	LINDENMEYR MUNROE PAPER
123	33207	EAST RUTHERFORD STEEL ERECTORS	127	G000000406	BECTON DICKINSON & CO
138	G000028297	PATERSON PLANK ROAD & MURRAY HILL PWY	130	G000001228	UNIVERSAL OIL PRODUCTS INCORPORATED
108	16779	COOPER LUMBER CO	32	14490	MATHESON TRI GAS INC
119	27108	ST MARYS CHURCH	35	3011	GENERAL FOAM CORP
83	G000063020	BOILING SPRINGS SAVINGS BANK	154	13228	JOINT MEETING RUTHERFORD E RUTHERFORD
15	6188	HY TEST	10	13505	PASQUIN MOTOR SALES INC
36	32765	BERLIN & JONES CO INC	111	18206	RIDGE SERVICE
97	9077	PARK MOTORS INC	30	540	MEADOWLANDS XANADU
165	300958	SABRINA'S EDUCATION STATION			

NOTES:
1. This map was created, in part, using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not State-authorized.
2. Some sites have multiple designations (e.g., Superfund site and GNL site).
3. The origin and contribution of non-point sources of hazardous substances is not indicated on the figure.

SOURCE:
1. NJPDES Locations, NJDEP GIS Digital Data, 2009
2. NJDEP KCS, NJDEP GIS Digital Data, 2009
3. GNL Sites, FTI Consulting, March 2011
4. Former STP, NJDOH 1930 and BSAWA 1983
5. Historic Landfill/Dump Sites, LECG, 1/29/2009
6. Observed Outfall Locations, Geosyntec, 2010
7. Microsoft Virtual Earth World Imagery, Microsoft Corp., 2009

0 500 1,000
Feet
SCALE: 1 " = 500 '

TITLE: FIGURE 1C
APPROXIMATE LOCATIONS OF IDENTIFIED CONTAMINATED SITES
AND POTENTIAL PAST OR CURRENT DISCHARGES
IN THE BCSA, BETWEEN ROUTE 3 AND PATERSON PLANK ROAD

LOCATION:
BERRY'S CREEK STUDY AREA
BERGEN COUNTY, NEW JERSEY

DATE: 7/5/2011

FILENAME: KCS_NPDES_MBC_final.mxd

THE ELM GROUP
218 WALL STREET, PRINCETON, NEW JERSEY 08540
4920 YORK ROAD, SUITE 290, HOLICONG, PENNSYLVANIA 18928
612 MAIN STREET, BOONTON, NEW JERSEY 07005
267 BROADWAY, FIFTH FLOOR, NEW YORK, NEW YORK 10007
2475 BAGLYOS CIRCLE, BETHLEHEM, PENNSYLVANIA 18020
www.exploreELM.com

K:\206158_Berrys Creek\Data Management\GIS\Map Documents\NPDES\final\KCS_NPDES_MBC_final.mxd

LEGEND

- Berry's Creek Study Area (BCSA) Boundary
- 16 General Notice Letter (GNL) Recipients and ID Number
- 1 Superfund Site Location and ID Number
- 1 New Jersey Pollutant Discharge Elimination System Location (NJPDES) and ID Number
- 1 NJDEP Known Contaminated Site Location (KCS) and ID Number
- Landfill (Approximate)
- Historical Landfill\Dump Site (Location Approximate)
- Outfalls Observed During Phase I

GNL Sites:

LABEL ID	SITE NAME
45	Waste-Avon Landfill
46	Waste-Riparian Area
47	Waste-Viola Area

NJDEP 2009 NJPDES Sites:

LABEL ID	NJPDES ID	FACILITY NAME
2	NJ0002011.001A	Sika Corporation
3	NJ0002011.002A	Sika Corporation

NJDEP 2009 Known Contaminated Sites

LABEL ID	SITE NUMBER	SITE NAME
45	013196	MAINTENANCE DISTRICT 8
74	G000041696	1099 WALL ST W
78	032004	VITALE BUILDING CO INC
81	255338	SOLGAR VITAMIN & HERB
82	481423	210 CLAY AVENUE
109	016934	160 CHUBB AVE
110	018089	WAREHOUSE 1250 VALLEY BROOK AVE
115	022884	WEDGEWOOD PLAZA
120	031261	AN CORP REALTY
128	G000000933	ARDMORE CHEMICAL COMPANY
153	003849	AVON SANITARY LANDFILL
162	246699	240 CHUBB AVENUE
167	002207	DE MASSI CADILLAC

NOTES:
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2. Some sites have multiple designations (e.g., Superfund site and GNL site).
3. The origin and contribution of non-point sources of hazardous substances is not indicated on the figure.

SOURCE:
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2. NJDEP KCS, NJDEP GIS Digital Data, 2009.
3. GNL Sites, FTI Consulting, March 2011
4. Historical Landfill/Dump Sites, LECG, 1/29/2009
5. Observed Outfall Locations, Geosyntec, 2010
6. Microsoft Virtual Earth World Imagery, Microsoft Corp., 2009

N

0 600 1,200

SCALE: 1 " = 600 '

TITLE:

FIGURE 1D
APPROXIMATE LOCATIONS OF IDENTIFIED CONTAMINATED SITES
AND POTENTIAL PAST OR CURRENT DISCHARGES
IN THE BCSA, SOUTH OF ROUTE 3

LOCATION:

BERRY'S CREEK STUDY AREA
BERGEN COUNTY, NEW JERSEY

DATE: 7/5/2011

FILENAME: KCS_NPDES_LBC_BCC_final.mxd

THE ELM GROUP
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SUPPORTING INFORMATION

RESPONSE TO COMMENT #106

WATER QUALITY
IN A
RECOVERING ECOSYSTEM

Dave

See p. 46+47 for WQ Monitoring stations

Chet Mattson

8-221-2322

•

A Report on Water Quality
Research and Monitoring
in the
Hackensack Meadowlands
1971 - 1975

THE GREAT SEAL OF THE STATE OF NEW JERSEY

STATE OF NEW JERSEY
HACKENSACK MEADOWLANDS
DEVELOPMENT COMMISSION

•

Chester P. Mattson
Nicholas C. Vallario

JANUARY, 1976

STATE OF NEW JERSEY

HACKENSACK MEADOWLANDS DEVELOPMENT COMMISSION

•

PATRICIA Q. SHEEHAN
Chairman

•

JOHN BELL

MICHAEL J. BRESLIN, JR.

EDWIN J. DOYLE

ISADORE GLAUBERMAN

RICHARD D. MILANO

JOHN E. VAUGHAN

•

WILLIAM D. McDOWELL
Executive Director

JANUARY, 1976

WATER QUALITY IN A RECOVERING ECOSYSTEM

INTRODUCTION

In 1970, the Hackensack Meadowlands Development Commission undertook the first systematic look at water quality in the Hackensack Estuary, with the results published in a Report of the Commission entitled, "Water Quality in a Disordered Ecosystem." Its purpose was two-fold: first, as part of a Natural Resource Inventory on which to base the Land Use Planning decisions to follow; and second, to establish a base of information against which to make future comparisons and around which to organize subsequent, expanded research efforts.

Its reference points, in parameters monitored and in stations chosen for observation, were estuarine, reflecting the findings of Dr. E. E. MacNamara and Dr. George Potera whose 1969 walks across these marshes gave both feeling and force to the notion that the fragmented Hackensack Meadowlands were still an ecosystem. He who chose to see them differently, warned MacNamara (as, say, a polluted river or a 50-year landfill opportunity -- both popular perceptions at the time), chose to disconnect nature. For MacNamara, as for others who then built upon his work, vegetation was the key. Plants waving above the wetlands could "predict" the chemistry of the waters and soils which would be discovered below. Dr. Jack McCormick, later, was to describe this marsh/estuarine ecosystem as "unwired," stressing, in his various works, the biologically unified perspectives which would have to be pursued here.

This paper, "Water Quality in a Recovering Ecosystem," is organized around the same premises as its 1970 predecessor: the estuary is the biological unit being monitored. The title, however, suggests its first major finding: that the ecosystem surveyed again in this study -- the Hackensack River and its attendant wetlands -- shows key signs of recovery. Further, this report's format will be seen to have been significantly expanded. Not only are annual comparisons made to the water quality findings of the 1970 study. In addition, extensive, further studies into the system's hydrology, chemistry, and biology, also performed since 1970, are summarized herein, organized as follows.

First, biology research (at page 7), in which studies performed by Dr. Richard LoPinto have generated bio-assay techniques which utilize plankton as the experimental organisms; and which techniques have been applied by Dr. LoPinto to portions of the estuary to determine the effects

(a) of various nutrient loadings, and
(b) of various industrial wastewater discharges

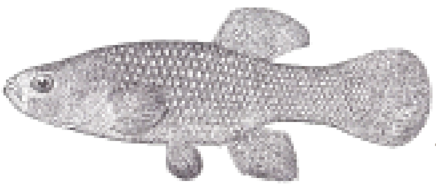
on indigenous plankton populations, the base of the estuarine food web.

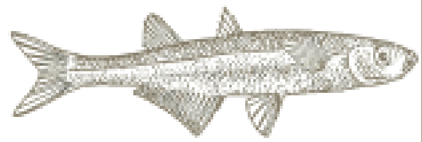
Second, hydrology research (at page 12) -- which has indicated how the daily tidal prism is distributed to the various creeks, wetland units, and river segments in the estuary.

Third, chemistry research (at page 26) -- in which nutrient budgets have told us the extent to which given wetland units assimilate the daily sewage treatment plant and tide-delivered loadings of such nutrients as nitrogen and phosphorus. This research, supported by the Victoria Foundation, is conducted as a joint effort among the Commission, the New Jersey Institute of Technology, Woods Hole Oceanographic Institution, and the Marine Biological Laboratories.

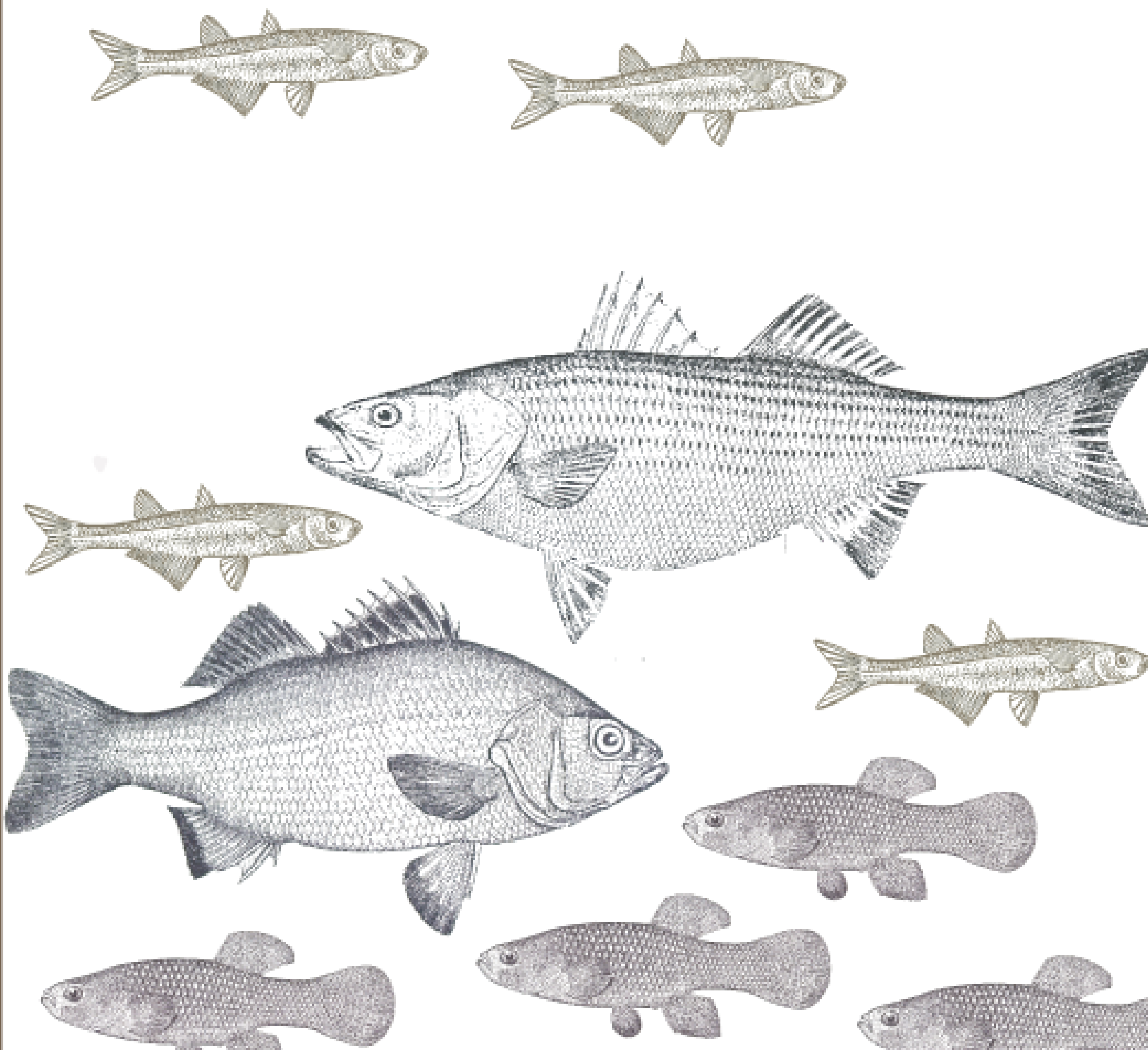
Finally, of signal importance for water quality planners, a different set of hopes and expectations for the Hackensack River has formed over the five years since the 1970 report. Such hopes, embryonic at that time, were nonetheless strong enough to supply the key environmental decision around which Land Use Planning then occurred -- the decision that the River should constitute the core of the Master Plan. In retrospect, that decision was a good one. Land Use patterns and Water Quality characteristics have changed for the better in this basin since 1970. This report, in its various facets, recites the biology, hydrology, and chemistry of those changes.

A FISHERY RESOURCE INVENTORY OF THE LOWER HACKENSACK RIVER WITHIN THE HACKENSACK MEADOWLANDS DISTRICT





A COMPARATIVE STUDY
2001-2003 & 1987-1988



NEW JERSEY MEADOWLANDS COMMISSION
MEADOWLANDS ENVIRONMENTAL RESEARCH INSTITUTE

A FISHERY RESOURCE INVENTORY
OF THE
LOWER HACKENSACK RIVER
WITHIN THE HACKENSACK MEADOWLANDS DISTRICT

A COMPARATIVE STUDY
2001-2003 vs. 1987-1988

New Jersey Meadowlands Commission
Meadowlands Environmental Research Institute

by

A. Brett Bragin, Jeff Misuik, Craig A. Woolcott, Kirk R. Barrett, and Rafael Jusino-Atresino

May 2005

turbid at the upriver sites. However, there was a nearly consistent spatial pattern during both studies: water clarity decreases as one moves upriver.

Although it is difficult to discern large differences in water quality from the direct comparison of the water quality data measured during the two studies, several events have taken place within the Meadowlands since the 1987-88 study was conducted that have lead to water quality improvements in the 15 years between fishery resource inventories. Among these are;

- Proper closure of several landfills, which has sent approximately 1.5 billion gallons of leachate to sewage treatment plants instead of the river and its wetlands
- Four small sewage treatments plants have been closed down. Rather than discharging their minimally treated sewage into small creeks that lead into the river, the sewage from these plants is now sent to two large, regional sewage treatment plants.
- The two large regional sewage treatment plants have been upgraded, and now discharge effluent that is “cleaner” than in the past.
- Eight wetland restoration projects have restored approximately 600 acres of formerly tide restricted *Phragmites* dominated wetlands to full tidal inundation. These restoration projects have allowed fish and invertebrates renewed access to these marshes.
- Cessation of approximately 645 million gallons per day of once-through non-contact cooling water from the PSE&G Bergen Generating Station. We suspect that the removal of this thermal impact to the upper river, along with the elimination of the losses of fish and invertebrates formerly associated with this large withdrawal of water is a key factor in the improvements to the fish community seen in the upper river.
- Beneficial re-use of treated sewage effluent. A portion of the effluent that would normally be discharged directly to the river by the BCUA Little Ferry Treatment Plant is now sent to the PSE&G Bergen Generating Station for re-use as cooling water in a closed-loop cooling system.

4.6 Analysis of Ecological Indices

To determine if the change in the fish community between 2001-03 and 1987-88 was significant, the statistics of community structure calculated were analyzed using an adapted t-test to statistically compare the fish community data (see Section 2.6.3). This analysis revealed that the difference between the 1987-88 and 2001-03 fish community for the river as a whole (i.e., all 21 locations combined) was highly significant (at p=0.01). Further analysis compared pooled data from the lower, middle and upper portions of the river and from the tributaries (Table 22). For each river section, the species richness and abundance data from one location sampled by each gear type were combined and compared with its 1987-88 counterpart. For the lower river, species richness and abundance data from sampling locations GN1, S1, TN1 and T1 were used. Sampling locations used for the middle river included GN2, T3, TN3 and S2, while the data used for the upper river consisted of S3, TN5, T5 and GN3. This is similar to the way the fish community was examined (without the statistical analysis) during the 1987-88 fishery resource inventory (Bragin, 1988). Comparing the data in this way revealed that the fish community in both the middle and upper portions of the river were significantly different (p=0.01) between the two studies. However, no difference in the fish community was discerned between 2001-03 and 1987-88 for the pooled tributary data or in the lower portion of the river.

In an effort to determine which sites contributed to the significant differences between the pooled data sets, we applied the t-test described in Section 2.6.3 to the paired data sets for each of the 21 site locations. The results of the ecological index calculations by individual site locations (grouped by gear type) are presented in Table 23. A graphical comparison of the species richness (total number of species) and the Shannon-Wiener diversity index calculated for each sampling location for each collection period is provided in Figure 28. The comparison on a site-by-site basis revealed that the Shannon-Wiener diversity index was significantly different at only four sites between the studies (S2, TN4, T5, and T9). Since the data from sites TN4 and T9 were not included in the analysis of the three river zones mentioned above, we conclude that the fish community within the middle river was significantly different due to the data from site S2. The difference is clearly related to the number of fish collected, as during the 1987-88 collections 16,231 more fish (mainly mummichog) were collected at S2, while the species richness only increased by one species in 2001-03 (seen in the upper graph in Figure 28). The 2001-03 abundance data were much more evenly distributed amongst the 15 species collected at S2. For the upper river, T5 appears to be the driving force behind the difference in the fish community. Although the total number of fish collected was similar between studies (with only 151 more fish captured in 2001-03), species richness increased from seven during 1987-88 to 12 during 2001-03. A more even distribution of the 678 fish collected at T5 during 2001-03 is responsible for the difference.

4.7 Summary

A comparison of two fishery resource inventory studies of the lower Hackensack River conducted 15 years apart has shown that although many of the same fish species still use the river, there was a significant difference between the fish communities that use the upper and middle portions of the river (within the Hackensack Meadowlands District). No difference was seen in the fish community within the lower, more industrial portion of the river. Although the water quality data collected during the two studies was not designed to rigorously test for significant differences in water quality, the data show an improvement in the water temperature in the upper portion of the river, as well as improvements to the dissolved oxygen levels throughout the Meadowlands District portion the river. Over the 15 years that has elapsed between studies, large increases in the abundance of desirable game species, such as white perch, striped bass, weakfish and bluefish, and forage fish (gizzard shad, striped killifish, and Atlantic silverside) as well as an important invertebrate, the blue crab, have occurred. There has also been an increase in the numbers of diamondback terrapin that inhabit the river. All of this, in addition to the large increases in the numbers of pollution sensitive amhipods collected as by-catch during the fisheries collections attest to the improvements in water quality that have slowly occurred between the 1987-88 and 2001-03 studies.

NEW MILFORD
CRESSKILL
SCHRAALENBURG
RIVER EDGE
BERGEN FIELDS
TENAFLY
HAWTHORNE
HALEDON
ARCOLA
SPRING VALLEY
NEW BRIDGE
CHERRY HILL
HIGHWOOD
FAIRMOUNT
DUNDEE LAKE
ROCHELLE PARK
MAYWOOD
ENGLEWOOD
LAKE VIEW
HACKENSACK
TEANECK
BOGOTA
NORDHOFF
LODI
CLIFTON
ATHENIA
GARFIELD
LEONIA
HASBROUCK HEIGHTS
RIDGEFIELD PARK
PALISADES PARK
LITTLE FERRY
PERU
WOODRIDGE
CARLSTADT
BROOKDALE
DELAWANNA
MOONACHIE
RIDGEFIELD
RUTHERFORD
FRANKLIN
NUTLEY
LYNDHURST
FAIRVIEW
EDGEWATER
AVONDALE
SHADYSIDE
KINGSLAND
GRANTON
BULLS FERRY
BLOOMFIELD
ESSEX
GUTTENBERG
SOHO
BELLEVILLE
SECAUCUS
NEW DURHAM
FOREST HILL
WATSESSING
NORTH NEWARK
SCHUYLERS CORNER
SCHUETZEN PARK
UNION
WOODSIDE
ARLINGTON
SNAKE HILL
TYLERS
KEARNEY
HARRISON
HOBOKEN
HUDSON RIVER
NEW YORK
MARION
BERGEN
JERSEY CITY
WEST BERGEN
COMMUNIPAW
LAFAYETTE
CLAREMONT
WAVERLY
GREENVILLE
NEWARK BAY
CONSTABLE POINT
ELIZABETHPORT
BERGEN POINT
KILL VAN KULL
GEOLOGICAL SURVEY OF NEW JERSEY.
JOHN C. SMOCK, STATE GEOLOGIST.
MAP OF
HACKENSACK MEADOWS.
TO ILLUSTRATE REPORT ON DRAINAGE
BY C. C. VERMEULE, CONSULTING ENGINEER.
1896.
Scale of Feet
1000 500 0 1 2 3 4 5,000
Scale of Miles
1 3/4 1/2 1/4 0 1 2
+ + + + Existing Dykes ...... Proposed Dykes.
Figures on meadows indicate depth in feet of mud below natural meadow surface.
(2.1) Figures enclosed indicate present height in feet of meadow surface above mean sea level. (minus sign indicates below) Where meadow is below (2.5) it has shrunk after dyking, and depths of mud shown are too great for present conditions.
Figures on water indicate depth in feet below mean low tide. Mean low tide is about 2.4 feet below, and mean high tide about 2.4 feet above mean sea level.

Berry's Creek Study Area
Phase 1 Site Characterization Report – Responses to Agency Comments

Appendices

Appendix C SPI

155. It may not be necessarily accurate to say that the estimates of biologically active zones are "conservative" when they are given as minimum values (true value is beyond the camera's field of view). If the data will be used to assess whether ecological receptors will be exposed to buried contamination, it may actually underestimate of the actual BAZ.

Response: The BAZ is intended to capture the zone where the vast majority of the biological activity in sediment occurs. If an ecologically-relevant receptor is determined to be using a sediment layer below the BAZ some portion of the time, sediment data are available from deeper horizons and would be used in the exposure analysis.

156. Using the mean for each segment of the river may not give a representative BAZ, for two main reasons. One reason is that as noted above, some of the BAZ values given are actually minimum values because the BAZ extended deeper than the range of the SPI camera. Second, Figure 3 shows that the measured BAZs are highly variable, and if the argument is going to be contamination deeper than 10 cm is not an issue because it's not in the biologically active layer then it should be noted that there are 21 of ~60 sites where the BAZ was observed to be deeper than 10 cm. In UBC, there are several locations with no or minimal evidence of biological activity, not surprising since the burrows are narrow and it would be easy for a camera to miss them by going in between. Including these as 0 cm brings down the overall average. Perhaps using the 75th percentile depth would better represent the situation for any additional sampling planned. The following table gives statistics for the four segments of the river; again, these are minimum values because in about 25% of cases, the BAZ went deeper than the photo:

	upper	middle	lower	canal
Mean	6	11.5	10.45	9.75
75th percentile	9.1	16.15	14	13.675
90th percentile	10.2	16.7	15.9	14.26

Response: First, it is important to distinguish that Berry's Creek is a tidal stream in a side embayment/fringing marsh system and is not a "river" as described by the commenter. Because of that difference, the subsurface sediment conditions are likely to be less variable than typically seen in river bottom assessments. With regard to using a mean for the BAZ, in strongly reducing sediments, like those found in the BCSA, the biological activity of metazoans (aerobic organisms) is strongly skewed towards the surface water-sediment interface where oxygen is more available. The result is that the occurrence and level of activity (e.g., feeding) is biased towards the surface. For this reason, the BAZ estimates are regarded as conservative. The few organisms that spend time below the designated BAZ depth typically do so as predator avoidance behavior and are minimally active because their physiology requires oxygen and these subsurface areas include non-COPC stressors (e.g., anaerobic conditions, sulfides, ammonia). Consequently, biasing the BAZ to 75^{th} or 90^{th} percentile would lead to a less accurate representation of where biological exposure occurs.

157. More description should be provided regarding how the 60 representative images were selected from the 501 taken. The map shows all the sites where photos were taken; those that were actually used in the analysis should be highlighted and some narrative provided to explain the process. In addition, more description should be given regarding what the "SPI concept regions" on figures C-1 through C-4 are.

Response: The 501 SPI photographs were screened based on the clarity/interpretability of the photograph, distributed to ensure consistent coverage among the study segments, depth of sediment penetration considering the sub-habitat (e.g., less penetration was typical in pools) and in clustered sets to provide for comparability at locations along the study area. The final breakdown of SPI image analysis is provided below.

Reach	Intertidal	Sub-Tidal	Deep Pool	Total
LBC-01	1	2	1	4
LBC-02	2	1	1	4
LBC-03	2	1	1	4
LBC-04	2	2	0	4
Total	7	6	3	16
Reach	Intertidal	Sub-Tidal	Deep Pool	Total
BCC-01	2	2	0	4
BCC-02	1	3	0	4
BCC-03	2	2	0	4
Total	5	7	0	12
Reach	Intertidal	Sub-Tidal	Deep Pool	Total
MBC-01	0	2	1	3
MBC-02	2	1	1	4
MBC-03	3	2	0	5
MBC-04	1	2	1	4

Total	6	7	3	16
Reach	Intertidal	Sub-Tidal	Deep Pool	Total
UBC-01	1	2	0	3
UBC-02	2	1	1	4
UBC-03	2	1	1	4
UBC-04	2	2	1	5
Total	7	6	3	16
			Grand Total	60

The SPI concept regions are subsegments within each study reach that were the primary focus of the SPI program. These areas were selected to capture the range of conditions present within the BCSA, including: (i) both subtidal and intertidal locations within the primary waterway; (ii) both channel meander bends and channel straight-aways, (iii) both shallow and deep bathymetric bedforms, and (iv) the prevailing conditions within each of the four study segments.

<u>Appendix F</u>

158. The findings of the cultural resources investigation are still under review by appropriate EPA staff.

Response: Two additional agency comments regarding the cultural resources appendix were subsequently provided to the Group on April 12, 2011, as follows.

a. *The report presents the results of a well designed and executed historic background and sensitivity study for the Area of Potential Effect (APE), associated with the Berry's Creek Study Area. A clear appreciation is provided concerning the varied processes of environmental change that the Area has been subject, and of the effect of human occupation with respect to the continued modification of the landscape. The contemporary combination of wetlands and waterways provide considerable challenge to the effort to identify significant surviving historic properties. Standard field methodologies cannot be employed as shovel tests and test squares excavated into contemporary near surface strata would not be expected to encounter materials associated with significantly older occupations. As is noted in the report, such testing should be preceded by a geomorphological investigation to better determine the potential for the existence of appropriate sub soils. That factor and the extensive size of the Study Area suggest the need to initially identify those areas where soil impacts will occur as part of any proposed remedial action, prior to carrying out such studies.*

Response: Comment noted. If remedial actions are proposed within areas identified in the Stage 1A Cultural Resources Investigation as having potentially moderate to high sensitivity for prehistoric resources, the need for further evaluation by a geomorphologist and/or a Stage IB archaeological survey will be evaluated.

b. Based on the nature and extent of the areas to be subject to remedial soil impact, a design for a geomorphological study and any subsequent archaeological field survey could then be developed. The timing of such work and the evaluation of any identified significant historic properties is an important consideration. A discussion of the contaminant distribution and parameters of the feasible remedial approaches should be provided to best anticipate what future historic property considerations might be needed.

Response: Comment noted. Distribution of COPCs and potential remedial alternatives will continue to be evaluated throughout the remainder of the Remedial Investigation/ Feasibility Study. Historic and cultural resources will be considered during the analysis of remedial alternatives and during remedial design.

159. Appendix F: The following minor omissions and issues were identified:

1. Page 4-12 from Section 4.3 has been omitted.

Response: The page numbering incorrectly skips from page 4-11 to 4-13, but no text is missing from the report.

2. Figures within the report [specifically, the Soils Map (Figure 3.2) and the 1849 Sidney's Map of Twelve Miles Around New York City (Figure 4.5)] are difficult to read and should be re-printed.

Response: More legible versions of Figures 3.2 and 4.5 are provided as attachments to this submission.

3. *For Figures 4.5 and 4.6 (both historic atlas maps), the geo-referencing of the approximate location of the Area of Potential Effect (APE) appears to be slightly inconsistent, resulting in a discrepancy with respect to the location of historic structures in relation to the APE. Figures need to be revised. The text does not make any reference to this inconsistency, which most likely reflects inaccuracies that are intrinsic to the process of geo-referencing modern coordinates onto historic maps. Clarification regarding the inconsistencies between the two maps and with respect to the location of mid-nineteenth century historic structures in relation to the APE is required.*

Response: As noted by the reviewer, the approximate location of the APE is slightly different on Figures 4.5 and 4.6 as a result of geo-referencing issues related to historic maps. The position of the APE is accurately depicted on Figure 4.6. On Figure 4.5, the north-south trending road located in the western portion of the BCSA, as well as the structures situated along the roadway, should be located outside of the APE. Additional evaluation of potential impacts to historic resources will be conducted if needed during alternatives analysis and remedy selection for the site.

Appendix G – SLERA Phase 1 Report

169. Appendix G, General Comments: PCDD/F must be included in the Screening Level Ecological Risk Assessment (SLERA). PCDD/F are known to be highly bioaccumulative and toxic to higher trophic level animals. Information presented in Section 2.3.3.6 of the Phase 1 Site Characterization Report shows that PCDD/F were analyzed in a large number of sediment samples from Berry's Creek and many of the 17 congeners were detected throughout the Study Area. Data presented in Table J-1 of the Site Characterization Report shows that average concentrations of 2,3,7,8-TCDD[1] exceeded the screening concentration of 3.6 pg/g by a factor of 11 in Berry's Creek Canal, factor of 15 in Lower Berry's Creek, factor of 13 in Middle Berry's Creek, and factor of 4 in Upper Berry's Creek. PCDD/F must be included in the SLERA and screened in a manner consistent with Section 2.2 of the SLERA. In addition, statistical comparison of PCDD/F sediment data for the Berry's Creek Study Area and reference area must be conducted in a manner consistent with Section 2.8.2.1 of the Phase 1 Site Characterization Report and used for other constituents and environmental media.

Since PCDD/F are more toxic to higher trophic level organisms, the use of sediment screening benchmarks that are protective of benthic invertebrates is not totally acceptable for the purpose of identifying contaminants of potential ecological concern (COPECs). For example, in Table G5 of the SLERA PCB-1254 and PCB-1260 were not identified as exceeding sediment benchmarks, but did exceed tissue benchmarks. It is more appropriate to screen PCDD/F with benchmarks protective of higher trophic level organisms, such as the dietary benchmarks from ORNL used in the SLERA. This requires that fish tissue samples be collected during Phase 2 and analyzed for PCDD/F. The collection of fish tissue data for PCDD/F analysis has the added benefit that it provides an empirical estimate of site-specific bioavailability and enables all congeners to be included in the evaluation through the use of Toxic Equivalent Factors (TEFs).

Response: As discussed in Section 2.3.3.6 of the Phase 1 report, no evidence of a site-specific source of PCDDs/Fs was identified in the BCSA based on Phase 1 data. PCDDs/Fs are considered regional contaminants for the reasons outlined in Sections 2.3.3.6 and 3.6.2 of the Phase 1 report and therefore are not selected as COPECs. As noted by USEPA in Phase 1

[1] The only PCDD/F congener having a screening concentration in the Phase 1 Site Characterization Report is 2,3,7,8-TCDD.

Report comment #76, tidal interactions with Newark Bay are likely a primary source of PCDDs/Fs to the BCSA. Furthermore, the Phase 2 Work Plan Addendum (Geosyntec, April 2011) was approved without additional sampling requirements for PCDDs/Fs. Therefore, no additional collection of fish tissue for PCDDs/Fs is currently proposed.

PCBs and other bioaccumulative compounds were selected as COPECs if they were detected in fish and/or crab at concentrations that were above tissue-based benchmarks for wildlife, and thus, bioaccumulation processes were considered in the screening. The risks associated with BCSA COPECs should be the risks that are being evaluated for site-specific risk mitigation actions rather than regional contaminants from outside the BCSA, which will mask and distort the site-specific risks. Regional contaminants will be taken into account in the uncertainty section of the risk assessment.

170. Appendix G, General Comments: A section describing the presence of endangered or threatened species in the Study Area should be added to the SLERA.

Response: Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report. The potential presence of threatened or endangered species in the BCSA will be discussed in the Baseline Ecological Risk Assessment (BERA).

171. Appendix G, Section 2.1.1.3, Page 2-3: We agree that the inhalation route of exposure is typically less significant than the ingestion route. However, the fact that the inhalation route of exposure will not be quantitatively assessed should be acknowledged in the uncertainty analysis.

Response: Per the comment, the significance of the inhalation route will be discussed in the uncertainty analysis of the BERA.

172. Appendix G, Section 2.1.2, Page 2-4, and Table G1: The selection process for sediment benchmarks is not transparent and does not always identify benchmarks appropriate for a screening-level evaluation. Section 1.1 states that the SLERA has been conducted using conservative assumptions regarding exposure and toxicity, which is consistent with guidance. However, use of Effects Range Median (ER-M) values, which indicate adverse impacts to benthic organisms in more than 50 percent of cases studied, is not conservative and suitable for screening purposes except for those COPECs for which the ER-M is the most conservative criterion. Effects Range Low (ER-L) values are more appropriate for screening because they represent concentrations at which adverse benthic impacts were noted in approximately 10 percent of studies. In addition, the Study Area contains both freshwater and brackish water environments, so it would be appropriate to select benchmarks that are protective of both *environments. The New Jersey Department of Environmental Protection (NJDEP) Ecological Screening Criteria for sediments are appropriate for screening purposes and should be used as the first tier value, if available. Although it would be most appropriate to use the lower of the freshwater Lowest Effects Level (LEL) and saline water ER-L values, these values are not available for many constituents. Therefore, the lowest of the available freshwater and saline water NJDEP sediment criteria must be selected as benchmarks. If NJDEP sediment criteria are not available for a particular constituent, we agree that values should be selected from the National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables. Ensure that the selected benchmarks are protective of both freshwater and marine organisms and suitably conservative benchmarks are selected whenever available.*

Response: Please refer to the response to Comment #131 regarding selection of sediment screening criteria. Also, as alluded to in the comment, neither the ER-L or ER-M values are bright line thresholds in terms of potential site-specific toxicity; they represent concentrations along a continuum roughly relating bulk chemistry to toxicity.

173. *<u>Appendix G, Section 2.1.2, Pages 2-4 and 2-5:</u>* *In order to insure protection of freshwater biota in Upper Berry's Creek, it is necessary to account for the toxicity of the dissolved fraction of cadmium, chromium, copper, nickel, silver, and zinc in surface water. Apparently, these metals are currently evaluated only using benchmarks for saline waters because the dissolved freshwater criteria are hardness dependent and must be derived using equations provided in the New Jersey Water Quality Standards. One acceptable approach would be to derive a representative hardness value for Upper Berry's Creek using available data and use that value to derive dissolved benchmarks. Another acceptable approach would be to use the freshwater screening values provided in the NOAA Screening Quick Reference Tables.*

Response: Based on the data collected during the Phase 1 program, Berry's Creek largely has low to moderate salinity throughout its length, even in the upper studied reaches, therefore estuarine criteria are appropriate. Freshwater criteria will be considered and used in future comparisons if freshwater conditions prevail. Please also refer to the response to Comment #132 regarding selection of surface water screening criteria.

174. *<u>Appendix G, Section 2.1.2, Page 2-5:</u>* *It should be noted that constituents without benchmarks will be carried into the Baseline Ecological Risk Assessment (BERA) where they will be addressed in the uncertainty analysis.*

Response: Constituents without benchmarks will be addressed in the uncertainty section of the BERA.

175. Section 2.2.1, Page2-6: The selection process for determining the contaminants of potential ecological concern (COPECs) included the use of frequency of detection and comparison to reference areas. These methods are not appropriate for a screening level ecological risk assessment (SLERA) which is inherently conservative. Additionally, the sediment benchmarks used for screening of COEPCs in the SLERA (Section 2.1.2, SLERA Benchmarks, p. 2-4) involved, in most cases, using the upper end of the NJDEP screening benchmarks (e.g., ERMs). The Phase 1 report states, "... the low effect values such as the ERLs were not considered relevant for COPC selection screening in an urbanized and industrialized waterway in which the cumulative impacts of historical urbanization and development (outside of CERCLA releases) has led to a decreased in sediment quality." However, the ERLs are appropriately conservative for the SLERA and should be used instead of the ERMs.

Response: With respect to the overall intent of this comment, the primary purpose of the SLERA was to support a decision regarding the Scientific/Management Decision Point (SMDP) as to whether chemicals at the site pose an ecological risk and whether additional study is warranted. The secondary purpose was to indentify the chemicals, receptors, and pathways to be the focus of the subsequent BERA. The Group is confident that the approach used has appropriately identified the need for a BERA and the appropriate focus of that BERA. Though more conservative screening approaches might generate a larger chemical list, the relevance of these chemicals for supporting risk management decisions at the site is low.

With respect to the specific comments regarding the use of background data to identify COPECs, the approach used in the SLERA was designed to identify the *site-related* chemicals that potentially contribute to ecological risk in the BCSA and that might warrant further study. Because the entire Meadowlands region surrounding the site has a high background burden of chemicals in the surface water, sediments, and fish, background concentrations must be considered if the subsequent BERA investigation is going to be designed to address *site-specific* risks. USEPA's ERAGS guidance allows a refinement of the COPEC list during the refined problem formulation, but *before* the design of field studies. Because the problem formulation for the BERA has been on-going since the RI/FS scoping activities and Work Plan development where it was initially discussed, the refinement of COPECs to consider background was considered appropriate in the SLERA. Nevertheless, the Phase 2 field investigation includes a subset of samples for analysis of all TAL/TCL compounds. The results of this sampling will be evaluated in the BERA and the potential risk significance of any site-related chemicals will be assessed.

With respect to USEPA's comment regarding the use of ERMs, please refer to the response to Comment #131.

176. *<u>Appendix G, Section 2.2.2, Page 2-7:</u> The use of arithmetic average constituent concentrations in sediment, surface water, and tissues as exposure estimates are inappropriate in a screening level assessment. Section 1.1 of the SLERA states that conservative assumptions regarding exposure and toxicity were used, which is consistent with guidance. However, use of arithmetic average exposure estimates is neither conservative nor consistent with guidance. The reasonable maximum exposure point concentration must be used to estimate exposure in the SLERA.*

Response: Maximum detected concentrations were compared to benchmarks in the SLERA. The results of these comparisons are presented in Table G5.

Arithmetic average concentrations were used in a further evaluation of risks to assess the patterns of risk across BCSA study reaches and by chemical. The comparison of mean concentrations to benchmarks was conducted to refine our preliminary understanding of potential risks at the site and to identify the key chemicals contributing to ecological risk. The COPECs identified via this assessment will be the focus of subsequent data collection and the BERA. However, the final BERA report will include an evaluation of the risk posed by all detected site-related chemicals, and the Phase 2 investigation includes a subset of samples for the full TCL/TAL compound list.

177. *<u>Appendix G, Section 2.2.2, Page 2-7:</u> Text in the second paragraph of this section states that filtered surface water data was used to calculate Hazardous Quotients (HQs). Although use of filtered results is suitable for metals whose benchmarks are expressed on a dissolved basis, they are not suitable for organic constituents. Unfiltered surface water results for organics provided in Attachment 1 should be used to calculate HQs.*

Response: Risk evaluations in the BERA will consider unfiltered results, as appropriate.

178. *<u>Appendix G, Section 2.2.3:</u> The use of surrogates should be mentioned in the uncertainty analysis, as there are no criteria for certain COPECs in certain media, and so using surrogates introduces some uncertainty to the SLERA.*

Response: The use of chemical surrogates will be discussed in the uncertainty section of the BERA report.

179. *<u>Appendix G, Section 3.1, Page 3-1:</u> This section needs to include a more precise description of constituents identified as COPECs to be carried forward into the BERA. Although Section 2.2.1 identifies COPECs, information provided in Section 2.2.2 needs to be integrated into the finalization of identification of COPECs.*

Response: The SLERA COPECs selected for further evaluation in the BERA are TAL metals, methyl mercury, and PCBs.

180. <u>Appendix G, Table G1:</u> Indicate whether the tissue benchmarks are expressed on a fresh weight or dry weight basis.

Response: Tissue benchmarks are fresh weight. The source document is not completely clear on the units, but a review of the text and the method of derivation suggest they are fresh weight values. Further, our previous discussions with the developer of the benchmarks (Brad Sample of ORNL) indicated they are fresh weight.

181. <u>Appendix G, Table G1:</u> NOAA sediment criteria should specify whether they are marine or freshwater criteria in this table and all tables. Also, NOAA surface water criteria are not "saline", but rather "marine" and should be corrected in all tables.

Response: Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report. All tables in the Phase 2 Report will correctly identify sediment and surface water criteria as either marine or freshwater, where warranted.

182. <u>Appendix G, Table G1:</u> COPECs for which a surrogate value is presented should be noted in this table, as the cited source of these values below the table are the NJDEP or NOAA values, when in fact they are surrogates and represent the criteria for a different COPEC, and may not even be the same type of criteria type as the selected surrogate. For example, 1,2,3-Trichlorobenzene lists an LEL but the surrogate is an ER-M for 1,2-Dichlorobenzene. An asterisk should be used to indicate COPECs with surrogate criteria in Table G1.

Response: It is correct that the surrogate screening value for 1,2,3'-TCB was incorrectly listed as an LEL when it should be identified as an ER-M. This correction will carry through to the BERA report. We reviewed the remaining surrogates listed, and they are appropriately listed with the correct benchmark type. Table G-2 identified all the chemicals for which surrogates are used. Any future deliverables will note in appropriate tables any instance where a surrogate value is used.

183. <u>Appendix G, Table G1:</u> COPEC-specific criteria should be used whenever they are available. Sediment criteria for alpha and beta BHC should be used rather than the surrogates, as these COPECs have freshwater LELs. A surrogate was also used for indeno(1,2,3-cd)pyrene, though this COPEC has a NJDEP LEL which is lower than the selected surrogate (0.26 versus

0.2).

Response: We chose to use the more conservative sediment screening benchmark for the gamma isomer to represent all BHC isomers due to structural similarity. It is correct that the most recent NJDEP sediment standards update shows a screening benchmark for indeno(1,2,3-cd)pyrene. This was an updated value since we prepared the draft report. This change in the screening value (0.26 versus 0.2) will not affect the risk results. The current version of screening criteria will be considered at the time the BERA report is prepared.

184. <u>Appendix G, Table G1:</u> As noted for sediment above, Table G1 should note which values are surrogate values because as presented, the table presents specific criteria in cases where none exist for a COPEC. In all subsequent tables, any COPEC criteria which don't actually exist (all COPECs where a surrogate criterion is used) should be noted in the table.

Response: Any future deliverables will note in appropriate tables any instance where a surrogate value is used.

185. <u>Appendix G, Table G1-surface water criteria:</u> There seems to be a preference for using acute criteria instead of chronic criteria, despite the selection process described on page 2-4 which indicates that New Jersey Surface Water Quality Standard (NJSWQS) chronic criteria will be used as a first tier when available. For example, the aldrin NJSWQS saline acute criterion of 1.3 was used in the SLERA, though it is much higher than the NJSWQS and NOAA freshwater chronic criterion of 0.017, which would result in an underestimate of risk. The SLERA selected criteria for all four BHCs is the NJSWQS saline acute criterion for gamma, though alpha, beta, and gamma BHC all have freshwater chronic criteria. The NJSWQS saline acute criterion for silver of 1.9 was selected though the NJSWQS freshwater chronic criterion is much lower (0.12), and Table G1b shows maximum unfiltered silver result (1.70E-01) would exceed the NJSWQS freshwater chronic criterion. 2-methylnapthhalene has a NJSWQS and NOAA freshwater chronic value, but the NOAA marine acute criterion is used in the SLERA. Surface water criteria for the above COPECs should be changed to the most conservative criteria available.

Also, it seems that NJSWQS in the NJ ESC table with footnote #8 were not selected as benchmarks unless they also matched the NOAA criteria, which resulted in the use of higher criteria for some COPECs when lower NJ criteria were available. Footnote #8 states "USEPA Region 5, RCRA Ecological Screening Levels (ESLs) represent a protective benchmark (e.g., water quality criteria, sediment quality guidelines/ criteria, and chronic no adverse effect levels) for 223 contaminants and are not intended to serve as cleanup levels, but are intended to function as screening levels. <u>http://www.epa.gov/reg5rcra/ca/ESL.pdf</u> " As they are *intended as screening levels, their use in a SLERA is appropriate, and the SLERA used criteria with footnote 8 for at least 10 sediment COPECs. Appropriate NJSWQS in the NJ ESC table should be selected as benchmarks for the SLERA.*

Response: The Group did not give preference for chronic values over acute values; however, NJSWQS values, if available, were preferentially selected over NOAA benchmarks because the NJSWQS are promulgated values. Additionally, if no NJSWQS was available USEPA AWQCs were preferred over the NOAA values. As a result NOAA values were not relied upon if state or federal values were available.

The state values cited above for BHCs are human health values, not aquatic life values, and not appropriate in the SLERA.

The reviewer is correct in that the Group did not use USEPA Region 5 ecological benchmarks in its screening. The reason for this is that the study/technical basis for these values is unknown and therefore not sufficiently reliable for use. During discussions to gain a better understanding of the basis of these benchmarks, Region 5 representatives indicated that a consultant group derived the values, but that Region 5 only has the published results and not the toxicity data that serves as the basis for the benchmarks. Absent an understanding of the basis of these values, the Group did not use them in the screening.

Please also refer to the responses to Comments #131 and #132 regarding selection of sediment and surface water screening criteria.

186. The results of the sampling data from the reference sites indicate that there are elevated contaminant concentrations in the various media. The use of a reference area that has been impacted by contaminants similar to the site-related contaminants may not be useful for the purposes of the risk assessment.

Response: See response to General Comment #4.

187. <u>Appendix G, Table G3:</u> Cyanide is listed as a constituent lacking a sediment benchmark. However, a freshwater LEL for cyanide in the New Jersey surface water quality standards that, according to methodology described in the SLERA, must be used as the benchmark.

Response: This cited benchmark for cyanide is an USEPA Region 5 USEPA value. As stated in the response to Comment #185, the Group did not use Region 5 values because the basis for these values is not available to evaluate their relevance to the BCSA.

188. <u>Appendix G, Table G3 "Surface </u>Water": Antimony, barium, cobalt, thallium, and vanadium all have NJ SWQS freshwater aquatic chronic criteria but the SLERA claims that there are no benchmarks for these COPECs. The NJ ESC tables give footnote #8 for these COPECs, indicating their suitability as screening benchmarks. Looking at Table J3 in the Appendix J of the Phase 1 report, barium (NJSWQS criterion of 220) had an exceedance and vanadium (NJSWQS criterion of 12) had numerous exceedances of the NJSWQS criteria. Criteria for these analytes and their exceedances should be corrected in the appropriate tables.

Response: Please refer to the responses to Comments #132, #185, and #187 regarding selection of appropriate surface water screening criteria..

189. <u>Appendix G, Table G5:</u> A footnote to this table states that mummichog tissue data from reference areas was used to screen Study Area data for white perch and blue crab because this was the only species sampled in reference areas. Although lipid-normalization of organic constituent tissue data helps to address some inter-species differences, lifestyle differences between species may also have a large effect on bioaccumulation. Therefore, sampling of white perch and blue crab from reference areas should be included in Phase 2 and comparisons of Study Area to reference areas performed as part of the BERA to confirm COPECs for these species.

Response: The Phase 2 sampling program includes sampling of both white perch and blue crab from reference areas for COPCs. A detailed comparison of tissue concentrations between the BCSA and reference areas will be included in the Phase 2 Report and the BERA.

190. <u>Appendix G, Attachment 1 (Table G1a):</u> Table G1a should have a note below it stating that the sediment concentrations presented are for surficial sediments.

Response: It is assumed the reviewer is actually referring to Table G6a, as no Table G1a was presented in the SLERA. The data presented in Table G6a are for surficial sediments, as noted on page 2-7 in the SLERA text. Please refer to the response to Comment #17 regarding revisions to the Phase 1 Report. Tables presented in the Phase 2 Report will include a note regarding sampling interval, where appropriate.

191. <u>Appendix G, Attachment 1 (Table G1a):</u> The detection limit for a number of COPECs exceeds the criterion, but for those COPECs where there was a non-detect, the Maximum Detected Exceeds Benchmark column says "no". For example, for PCB-1242, the criterion is 3.00E+01, and the average sediment concentration using half of the detection limit for non-detects is 3.53E+01, yet the maximum is presented as a non-exceedance. However, if the average (half of the detection limit) exceeds the criteria, then it cannot be said that the *maximum does not exceed the criteria. This should be corrected by replacing “ND” in the max column with less than the detection limit (>#.##E-##) and the exceedance presented as “ND” or unknown, rather than assuming that an unknown maximum value is below the criteria.*

Response: These requested changes will be incorporated into future deliverables.

<u>Appendix H – Modeling Plan</u>

192. <u>Appendix H, Section1.1, Page 1-3:</u> The document is likely a part of CSM development rather than a modeling plan. A typical modeling plan consists of (a) model development, including model set up, model calibration, and model sensitivity tests, and (b) model application, including alternative scenarios. The document says, “The modeling plan describes a sequential process by which models will be applied during the BCSA RI/FS to support site management decision.” Further, it states, “An emphasis is placed on the collection of a robust empirical data set to support the development of accurate and comprehensive CSMs.” These two sentences suggest that the objectives are not clear. Clarify the objectives of the Modeling Plan.

Response: The Modeling Plan as presented in the Phase 1 Report addresses the full range of analyses that qualify as modeling. The reviewer’s comment appears to focus on the modeling plan for a numerical model, which may be one of the types of models employed at the BCSA Site. With regard to objectives of the Modeling Plan, the plan establishes a process to identify where models can be used as tools to describe site-related processes, relationships and exchanges in a qualitative and/or quantitative fashion and to forecast the effects of changing conditions that relate to study area questions. More detailed objectives will be developed as specific modeling activities are proposed.

193. <u>Appendix H, Section 3.1, Page 3-1, Second Paragraph:</u> The text indicates that a box model was used. Include details of the calibration of the box model, including the rational for using 18 boxes. Provide details of any sensitivity analysis conducted. How did assumptions at model boundaries (boundary conditions) affect the box model results? What bathymetry and bottom roughness were assumed?

Response: The box model described in the referenced section is the conceptual basis of the water budget analysis and is described in Appendix A of the RI/FS Work Plan (Geosyntec, 2009), including rationale for the segmentation of the system into boxes based on upland drainages and waterway features. Although such a model is not calibrated in the manner done for numerical computer models, the water budget box model was shown to be consistent with the conditions (e.g., salinity trends, water quality parameter responses to storm events, calculated tidal and freshwater fluxes) observed in the BCSA during the initial phases of Phase 1. Additional validation of the water budget box model will be completed during Phase 2 based on the larger monitoring data set (e.g., dye testing studies, upland runoff analysis). Sensitivity analyses were performed by testing the box model over a range of plausible values for the model inputs (e.g., tidal amplitude, precipitation magnitude, evapotranspiration rate). The model boundary conditions are defined by the inlets of the BCSA at the lower Hackensack River and the upland drainage boundary. The latter was defined by the USEPA and sensitivity of the model predictions to this area definition was not directly considered in the box model. The conditions at the BCSA inlets at the Hackensack River are well defined by the tidal amplitude data collected at moored stations MHS-01 and MHS-02. The bathymetry data collected during the scoping activities work (as augmented in Phase 1) were used to define the tidal prism for a range of tidal amplitudes. Bottom roughness is not relevant to water budget calculations.

194. <u>Appendix H, Section 3.1, Page 3-2 "Outfall Discharges":</u> Identify the location of the discharge records used to update the water budget in the report.

Response: The discharge locations were derived from the NJPDES Surface Water Discharges in New Jersey, (1:12,000) Version 20090126, New Jersey Department of Environmental Protection (NJDEP), Environmental Regulation (ER), Division of Water Quality (DWQ), Bureau of Point Source Permitting- Region 1 (PSPR1), dated 26 January 2009. Discharge records were acquired from a search of Daily Monitoring Report (DMR) data available from the NJPDES Open Public Records Act (OPRA) database system.

195. <u>Appendix H, Section 3.1, Page 3-4, Bullet "Flushing and Circulation":</u> Provide more detailed information or methodology describing how the data set will be used to calculate the exchange between segments and exchange with the lower Hackensack River.

Response: Salinity in the BCSA is derived from exchange with the River and thus temporal and spatial changes to the salinity gradient provide for an understanding of freshwater inputs, flushing, and circulation within the BCSA and exchange with the Hackensack River. The data collected from the moored stations constitute a long-term monitoring record of the BCSA hydrodynamics over a range of site conditions, such as tides, storm events, and outfall discharges. Trends in salinity (and other water quality parameter data) from the stations will be evaluated against other data sources (e.g., tidal elevations, precipitation amounts and predicted runoff quantities, wind speed/direction, dye test studies, timing and rate of discharge from the NJSEA outfall) to assess the response of the system, as a whole and between segments, to changes in system conditions. Analyses will be completed to quantify the observed water quality parameter response to specific perturbations of system conditions (e.g., large rainfall events, high winds, etc.) and to provide insight to the key processes affecting exchange within the system and with the lower Hackensack River.

Analytical calculations, such as calculation of dispersion rates and flushing times as described by Thomann and Mueller (1987) and Fisher et al. (1979), will be used to quantify system behavior over a range of observed site conditions.

196. <u>Appendix H, Section 3.1, Page 3-4, Bullet "Relationship of TSS and NTU":</u> Discuss the feasibility of a turbidity-TSS relationship approach to support the goals of this section, i.e., organic and inorganic sediment flux. In particular, describe how the variability and uncertainty in the relationship will be handled in flux calculations. Will ADCP backscatter also be used as a TSS surrogate? What is the backup plan if a successful calibration between Turbidity and TSS is not observed?

Response: As discussed during the August 4, 2010 work session with the USEPA and other stakeholders, quantification of the relationship of TSS to turbidity is complex and requires an approach based on multiple lines of evidence. Quantification of the relationship between suspended solids measurements and continuously monitored water quality parameters, such as turbidity, at the moored stations is a primary focus of the Phase 2 program (refer to the response to Comment #3). The program includes extensive TSS sample collection over a wide range of conditions, as well as characterization of other parameters likely to influence TSS concentrations/characteristics (e.g., chlorophyll-a, particle size distribution, and dissolved, particulate, and total organic carbon analyses). In addition, as discussed during the August work session, the relationship of ADCP backscatter data to TSS has been shown to be an effective surrogate for turbidity for estimating suspended solids in the BCSA. Collectively, the extensive data set developed through Phases 1 and 2 will provide for a robust understanding of the relationship of suspended sediments to the long-term, continuous data (turbidity, ADCP backscatter) collected at the moored stations. Uncertainty in this relationship will be considered in future calculations of sediment fluxes.

197. <u>Appendix H, Section 3.1, Page 3-5, Bullet "Sediment Balance":</u> The Modeling Plan assumes that field measurements of sediment loading from upland, quantification of sediment exchange between segments, and estimate of autochthonous production will provide the deposition rate in sediment balance calculation. This assumption is based on the accurate measurement and estimation of each term. Provide more detailed justification of sediment balance calculation in terms of uncertainty of the estimation relative to the sediment deposition rate.

Response: Two of the lines of evidence to answer the questions of sediment deposition rates and sediment balance are the geochronology data (Phase 1 and 2) and estimation of the current sources of sediment (e.g., upland runoff, autochthonous production/deposition, sediment transport from Hackensack River), measured directly in the BCSA to the extent practicable. These lines of evidence and other relevant factors (e.g., Sedflume results) will be evaluated concurrently to answer the related study questions and consider the uncertainty factors.

198. Appendix H, Section 3.2, Page 3-7, Bullet "Establish Relationship Between Particulates and COPC Movement": Section 3.2 needs to be further developed and should consider the following concerns: How will be variability in water column concentrations affect the COPC filter size fractionation study? Would a sediment transport calculation be conducted for each of the particle size fraction filtered from the water sample?

Response: The Phase 1 LISST data and the Phase 2 LISST data to date show a bimodal distribution in particulate size fraction, with one group of "fine" particulates (on the order of 10 μm size) and a second group of "coarse" particulates (on the order of 100 μm size). Because the observed system velocities are insufficient to maintain 100 μm particles composed of inorganic material (i.e., sand) in suspension, the coarse size particulates are organic in nature.

As described in Section 3.2.2.3 of the Phase 2 Work Plan Addendum, the particulate COPC fractionation task will involve quantification of the distribution of COPC concentrations between fine (mud, silt, clay) and coarse (sand size) particles through filtration methods. Samples will be collected at mid-flood and high-slack tide during two sampling events: one in warm weather and one in cold weather. These data will provide an understanding of the distribution of COPCs between the two primary particulate fractions in the BCSA and how this condition varies in response to organic productivity levels (high during warm weather, low during cold weather) and tidal phase. The results of this study will be used to assess the potential significance of suspended particulate size on COPC transport. Based on this analysis, a determination will be made whether further quantitative analyses are necessary to support risk analysis and remedy evaluations.

199. Appendix H, Section 3.2, Page 3-7, Bullet "Inorganic and Organic Fractions": Change "comprised" to "composed."

Response: Please refer to the response to Comment #17 regarding revisions to the Phase 1 report.

200. Appendix H, Section 3.2, Page 3-8, Bullet "Mercury Fate, Transport and Bioavailability": Will the pore water and sediments from the high resolution cores be analyzed for COPCs? It could be useful to spike the cores with Hg isotopes and determine rates of methylation/demethylation in the lab.

Response: As described in the Phase 2 Work Plan Addendum, the sediments from the high resolution marsh cores will be analyzed for total mercury and methyl mercury, as well as related parameters (sulfide/sulfate, AVS/SEM, total organic carbon, and biodegradable dissolved organic carbon). Porewater and isotopic analysis are not proposed at this time, but may be considered in future phases of work if the results of Phase 2 indicate that these analyses would provide useful data to support remedy selection.

201. <u>Appendix H, Section 3.3, Page 3-12, Third Paragraph:</u> Note that the Gobas models are for hydrophobic organic compounds and therefore would not be applied to mercury.

Response: Comment noted.

202. <u>Appendix H, Section 3.4:</u> Explain how the various components will be integrated to predict future recovery and risks? What assumptions will be made to forecast changes in sediment, water and biota COPC concentrations under natural conditions and other scenarios?

Response: Empirical models are being developed to predict sediment deposition/transport, chemical movement and bioavailability within different physical compartments of the system, and biological uptake in resident biota. These models will be used collectively to predict physical isolation, chemical movement and biological uptake in the future under natural recovery and active remediation scenarios.

203. <u>Appendix H, Section 3.4, Page 3-12, Last Paragraph:</u> "By understanding these processes across a range of conditions, it will be possible to forecast the likely effects of a remedial measure on site conditions." This statement also needs to be modified to include contingencies in the event that statistically valid relationships are not found.

Response: Forecasting likely outcomes at the ecosystem and landscape levels is based on a holistic understanding of the system processes and dynamics; statistical analyses are of limited value at these higher levels of system hierarchy. More detailed discussion of these analyses will be provided in the Phase 2 Report.

204. Page 3-7 in Phase 2 Work Plan describes dye tracer study: dye will be released in upper segment of Berry's Creek. How long is the dye visible and at what dilution can it be detected? I.e., will it be able to tell us about exchange between Berry's Creek and the Hackensack, or is it for smaller scales (just exchange between different segments of Berry's Creek)? If it's the latter, then another release point should be added at the downstream end. It is also noted that, "Detailed protocols for the dye study are provided in the project documents, as amended for Phase 2". It is not clear what these are and where they are.

Response: The protocols for the dye study are detailed in the Phase 2 Work Plan Addendum (Section 3.1.4) and in the Phase 2 QAPP Addendum (Section 2.4 of Appendix B and SOP 1.3 of Appendix C). Prior to initiation of the test, a calculation of the dye quantity required was made based on the anticipated conditions during the study (e.g., tide levels), such that sufficient dye was present to permit its detection following dispersal through the system. The dye was visible (to the human eye) for several hours, but injected at a quantity sufficient to permit its detection throughout the system following dispersal using the field flourometers (detection limit of 10 pptr under optimal conditions). Further, discrete samples were periodically collected for bench top analysis of dye fluorescence at a lower detection limit (1 pptr).

205. Biological activity is somewhat limited because of low dissolved oxygen, but it could still affect sediment stability/erosion potential (e.g. burrowing worms destabilizing sediment) and this effect would be seasonal. Therefore, sampling for sediment cores to analyze for resuspension potential should be timed to be representative.

Response: The Sedflume sediment cores will be collected in late July, the peak of biological activity and prior to the most sustained low dissolved oxygen periods (August) to provide representative results.

Appendix M

206. Appendix M, Page 1 and associated graphics: An error exists in Appendix M if the "Filtered Fraction" as defined in the appendix is the "concentration of a COPC in a given filtered sample divided by that of its associated unfiltered aliquot." The fraction should not exceed one.

Response: Note 2 on Figures M-1a through M-1g states "Filtered fractions that are greater than 1 indicate filtered sample results that exceed their corresponding unfiltered result. Such results are not theoretically valid and are likely due to sampling or analytical variability".

Appendix N BERA Work Plan

207. p. 2-5: Rutherford et al is missing from the references.

Response: The parenthetical reference to Rutherford, Avon and Lyndhurst identifies the names of historical unlined landfills in LBC, and is not a citation. This will be clarified in future documents.

208. p. 2-9: Kraus 1989 is missing from the references.

Response: The complete reference for Kraus (1989) was included on page 5-3 of Appendix N.

209. p. 2-10: The mummichog numbers are stated to be low because of the trawl sampling method used by NJMC. What sampling method is proposed for mummichog in Phase 2? The BERA work plan states that "similar methods" (to Phase I RI) will be used in Phase 2.

Response: Mummichog collection in both Phase 1 and Phase 2 was conducted using primarily minnow traps, supplemented with seine and gill netting where appropriate. A detailed description of the biota collection procedures is provided in Section 3.5.1 of the Phase 2 Work Plan (Geosyntec, October 2010), and in Field SOP 5.1 (Appendix C) of the QAPP (Geosyntec, October 2010).

210. Section 2.6, Page 2-17: A discussion of non-chemical stressors that exist in the Berry's Creek Study Area is included in the BERA Work Plan. However, the sole purpose of the BERA is to assess the risks associated with CERCLA contaminants regardless of the other stressors involved.

Response: As noted repeatedly in deliverables to the USEPA to date, the assessment of the CERCLA hazardous substances effects on the BCSA aquatic life must concurrently take into account the effects of the non-CERCLA stressors, which are known to be relatively important in highly urbanized areas. Therefore, the risk assessment, consistent with USEPA guidance, takes into account CERCLA and non-CERCLA stressors, while remedial actions are focused solely on reduction of CERCLA stressor risks, where warranted.

211. The negligible surface water chemical concentrations may be due to dilution, sorption, or sampling limitations. Perhaps high volume sampling techniques need to be evaluated for this study.

Response: Review of the detection frequencies presented in the surface water summary statistics (Phase 1 Report Appendix J, Table J-3) indicates that the current surface water sample collection procedure is adequate to measure COPC concentrations in the BCSA, if they are present. Comparison of total (unfiltered) vs. dissolved (filtered) surface water sample results indicates that for most COPCs, much of the COPC mass in surface water is associated with the particulate phase, which is consistent with the conceptual model for chemical fate and transport in the BCSA. COPCs were often detected in the dissolved fraction but were generally below the screening criteria (refer to Table J-3). Therefore, high volume sampling techniques are not warranted.

212. The BERA work plan should discuss more fully any relationships between tidal interface/density differences and salinity.

Response: The BCSA is a well-mixed estuary with no salinity or density stratification. This finding is well-supported by data from the moored hydrodynamic stations in BCC and UBC. Continuous monitoring data at both the top and bottom of the water column at these two locations indicate that salinity and temperature are essentially uniform throughout the water column. Water quality summary statistics are presented on pages 2-11 through 2-13 of the Phase 1 Report.

213. The BERA work plan includes an assumption that surface water risks are negligible. What about suspended sediment exposures, effect of high detection limits, seasonal or weather driven changes in chemical concentration and possible changes in bioavailability?

Response: Surface water risks will continue to be evaluated in light of the complete Phase 1 and Phase 2 dataset. Factors influencing risk associated with surface water exposures, such as those listed above, will be evaluated in the BERA.

214. The organisms being used as receptors in the risk assessment are pollution tolerant. While this is an urban waterbody, the goal should be to improve the water quality to allow native species to inhabit the area. Receptor species should be chosen based on their likelihood of susceptibility as well as their importance in a restored ecosystem. Certain species may be rare in the recent surveys. Perhaps they would return if the system was remediated. This issue also applies to Phragmites. It may not be appropriate to base a decision on allowing continued production of this invasive species.

Response: The BERA includes a wide range of assessment and measurement end points that are representative of the range of pollution tolerances found in the Hackensack River estuary. Goals for improved water quality can be realistically set for the BCSA using these species, consistent with State and regional (e.g., NJMC) goals for the Hackensack River estuary. With regard to *Phragmites*, its dominance in the Meadowlands pre-dates industrial discharges and was caused primarily due to hydrology and salinity changes resulting from other human activities. In addition, although invasive, its relative capacity to maintain highly productive tidal marshes in an urban ecosystem stressed by relative sea level rise will be a necessary part of the risk analysis.

215. Phase 2 will include an assessment of the interactions between the marshes and the waterway; it should also assess interaction between Berry's Creek and the Hackensack River. It is understood that the Hackensack River is not currently considered to be part of the BCSA but movement to and from the river is an important component to understanding the system overall.

Response: The revised Phase 2 Work Plan Addendum (Section 3.1) discusses the planned evaluation of the exchange between the BCSA and Hackensack River as a result of the tidal and freshwater exchange.

216. p. 3-10: *The BERA work plan notes, "Sediment toxicity of COPCs is likely limited or overall risks are less than risks to aquatic predators." Sediment toxicity testing should be conducted. Also, was pore water analyzed for metal concentrations? Since AVS is high, confirmation that pore-water concentrations are below AWQC would support limited bioavailability of metals.*

Response: The need for sediment toxicity testing and pore water analysis is being discussed with USEPA based on the evaluation of the Phase 2 benthic community data and other sediment data and risk assessment needs.

217. p. 3-12, Section 3.3.1, Measures of Exposure: The BERA work plan states, "COPC residues that exceed those detected in reference site biota will be used to assess site-specific exposure and risk." Literature values should be used to assess exposure and risk.

Response: Literature values will be used along with site-specific data to assess site-specific risks.

218. Section 3.1, Page 3-2: It is noted that based on acid volatile sulfide and simultaneously extracted metal (AVS/SEM) SEM metals in sediment are not bioavailable or likely to contribute to sediment toxicity. Under field conditions, the certainty of this method's predictive ability is relatively unproven and has significant limitations to its applications. For example, this method is not very useful in the more oxic conditions of the sediment which is where most of the biological activity exists. Additionally, use of the AVS/SEM approach requires that the sediments are never disturbed or changed from the parameters examined to make the ratio calculations. Therefore, the information used from this analysis should not be considered significant in the weight of evidence evaluation.

Response: These factors will be considered appropriately in the final weight of evidence evaluation presented in the BERA.

219. It is noted that for exposure to TAL metals (other than mercury) bioaccumulation is not an important pathway. However, Table G1c. (SLERA Tissue Screening Results) from Appendix G indicates that there are several metals in biota tissue which exceed benchmarks. Therefore, this further information should be provided to explain this discrepancy.

Response: The referenced statement in its entirety states "For exposure to TAL metals (other than mercury), bioaccumulation *with subsequent biomagnification* is not an important transport pathway" [emphasis added]. Although a number of metals were present in tissue at concentrations above wildlife benchmarks, only mercury, methyl mercury, and aluminum were detected in the BCSA at concentrations that were greater than concentrations detected in the reference sites. Of those three metals, only mercury and methyl mercury biomagnify in the food chain; biomagnification is not predicted to be an important pathway for other TAL metals.

220. Section 3.2.1, Page 3-5: The Assessment Endpoints included in the BERA do not include the benthic macroinvertebrate community. It may be appropriate to consider protection and maintenance of the benthic macroinvertebrates an assessment endpoint since they are an important part of the community and the food chain.

Response: As discussed during the February 2 and 3, 2010 meeting, the Group has evaluated the many factors that will likely influence COPC effects on benthic organisms in the BCSA. Based on this evaluation, the Group has recognized that prior to the Phase 2 work little was known about the benthic community in the BCSA waterways. The New Jersey Meadowlands Environmental Research Institute (MERI) collected a small number of samples in Berry's Creek Canal as part of a larger study of the Meadowlands (Bragin *et al*, 2009), and a limited study was completed in Oritani Marsh, which included a few samples in Berry's Creek Canal (Barrett & Mcbrien, 2007). In addition, limited benthic invertebrate community characterization was completed in the Eight Day Swamp area (Weis and Weis, 2003). No studies using consistent methods and sub-habitat stratification were conducted prior to the Phase 2 BCSA work. In addition, studies had not been completed in LBC or MBC, where there is a significant range of salinity and other parameters that influence benthic community composition. Consequently, the Group has implemented the benthic community survey across the BCSA study segments and the most representative reference area with regard to salinity and substrate composition (Bellman's Creek), to understand community composition and variability. The Group will evaluate the potential utility of the benthic community as a measurement endpoint based on the results of the Phase 2 work.

221. Section 3.2.2, Page 3-6: The Assessment Endpoints for the marsh include the marsh vegetation production, passerine songbirds, and aquatic mammals. Based on the reported mammalian species as presented in Table 2-2, it is recommended that additional assessment endpoints be added for the protection and maintenance of small mammal (e.g., shrew) and carnivorous avian populations (e.g., red-tailed hawk).

Response: No shrew were found in the marsh interior during mammal surveys completed within the study area (Kiviat and MacDonald, 2002). Shrew was not selected as an assessment receptor because they are predicted to occur in low numbers primarily along the marsh fringe areas rather than the marsh interior, which is subject to tidal inundation. These fringe areas are more terrestrial in character and not the area of focus for the RI/FS. Consistent with the ERAGS, they are not ecologically relevant receptors in the BCSA.

Passerine song birds were selected as the avian receptor species in the marsh over raptors because their smaller foraging range, in concert with a diet that can include aquatic as well as terrestrial insects, will result in higher calculated risks.

222. Section 3.3.1, Page 3-12: It is noted that tissue levels in reference site biota will be used to assess site-specific exposure and risk. However, literature values should be used to assess exposure and risk.

Response: Literature values will be used along with site-specific data to assess site-specific risks.

223. Section 3.3.1.1, Page 3-12: The measurement endpoint for the fish community involves surface water and sediment contaminant concentrations. Additionally, it may be appropriate to consider the comparison of fish tissue contaminant residue data with critical body residue effects concentrations/toxicity reference values as another measurement endpoint for the fish community.

Response: Residue-effect data will be considered in the risk assessment (along with data from other lines of evidence) if reliable and defensible critical body residue effect levels are available. Many of the published critical body residues available to date have significant data quality limitations and are of questionable reliability and applicability to the conditions in the BCSA. The BERA report will discuss available residue-effect levels and identify those reliable for use in the baseline assessment.

224. p. 4-4: *The BERA work plan notes, "Field based assessment of toxicity might be employed." This is an important part of the weight of evidence and useful for remediation goals and, therefore, should be considered.*

Response: Please refer to the response to Comment #220 regarding toxicity testing.

225. Section 4.3.3, Page 4-4: An area use factor will be used when calculating dose to ecological receptors. However, receptors that also forage beyond the limits of the Berry's Creek Study Area may continue to be exposed to contamination as a result of the urban watershed. Additionally, considering the size of the Berry's Creek Study Area it's conceivable that a receptor could forage entirely in the creek. Therefore, it may be appropriate to consider the area use factor equivalent to one.

Response: Area use factors (AUFs) will be species-specific. Species with smaller foraging ranges will likely have AUFs of 1 whereas species that roam across larger areas (e.g., great blue heron) will have smaller AUFs.

226. p. 4-5: The BERA work plan notes, "…the single point (i.e., deterministic) calculation of HQs will be accompanied by qualitative and possibly quantitative uncertainty analysis. This may include, for example use of probabilistic or bounding methods…" How will this be decided?

Response: The decision of whether probabilistic or bounding estimates are appropriate to support the deterministic HQ analysis will be dependent on the importance of the pathway in defining ecological risk at the site, the degree of uncertainty in the risk calculation, and the availability and adequacy of the data used to calculate the HQ values to develop distributions. Availability of supporting data for the input variables that are most critical for defining the potential risk (e.g., media concentrations) would determine whether a distribution or bounding approach would be most appropriate to supplement the deterministic HQ analysis. Although the chemical dataset will be robust with respect to defining input distributions for either the probabilistic or bounding approach, data for other inputs to the HQ calculation, such as ingestion rates or toxicity values, may be less definitive.

227. Page 4-5: The document states that, "…the single point (i.e., deterministic) calculation of HQs will be accompanied by qualitative and possibly quantitative uncertainty analysis. This may include, for example use of probabilistic or bounding methods…" Further information should be included regarding how this will be determined.

Response: See response to Comment #226.

228. It is indicated that field based assessments of toxicity might be employed.

Response: Please refer to the response to Comment #220 regarding toxicity testing.

229. The BERA work plan should discuss more fully any relationships between tidal interface/density differences and salinity.

Response: Please refer to the response to Comment #212 regarding water column stratification.

230. It is not clear how will methylmercury exposure-point concentrations be used in the BERA.

Response: Methyl mercury concentrations in sediment and surface water at the point of contact of a particular receptor will be used to understand and calibrate predictions of mercury bioavailability and uptake in biota. The concentrations of COPCs have been measured at locations and in sampling increments that are most representative of exposure points. Further refinements of this approach are anticipated in Phase 2 and 3. In addition, methyl mercury data in biological tissue will be used to assess potential exposures in wildlife predators.

Appendix O – Sediment Core Geochronology and COPC Data

231. The application of a "cesium horizon method" is questionable. If an appropriate Cs-137 peak cannot be identified, then the core has likely been disturbed, and the determination of the pre-1950 layer would not be appropriate as the assumption of constant deposition does not hold.

Response: There are multiple reasons why a ^{137}Cs peak may not be identifiable in a 1 m core that do not result from core disturbance. These include the following:

- The 10 cm interval used in Phase 1, could lead to a dilution of the sediment with peak activity with surrounding sediments of lesser activity. As a result, two or more consecutive samples may have elevated yet similar results with no clear peak identified.
- Changing sorptive characteristics of the sediments (e.g., an abrupt change in grain size distribution or organic carbon presence) could lead to spurious variations in radionuclide activity, which could confound analyses. For example, the loading of organic matter from sewage outfalls changed substantially repeatedly in quality and relative location between 1950 and present.
- Continuous, relatively rapid deposition may have occurred in the top 1 m at a particular core location, such that it represents post-1963 sediments; in such a case, the ^{137}Cs peak would be present deeper than 1 m.

As noted elsewhere in these responses, the Group will review the Phase 1 core data along with the Phase 2 data to support a consistent interpretation of the chronology data.

232. <u>Appendix O, Table O-1 (and associated downcore profiles)</u>: Mercury concentrations that were less than 1 mg/kg were only reported in sediment cores that penetrated the native layer (plus location 168). The majority of the Phase 1 low resolution cores was "incomplete" and did not capture the extent of contamination. Sediment cores need to be advanced to the native red-brown sand/clay or to refusal. It is recommended that Phase 2 sediment cores be advanced further than a pre-determined depth of 1 meter.

Response: Consistent with previous investigations, the Phase 1 coring clearly documented the highest concentrations of COPCs typically occur at depth in most areas of waterways and marshes. Also, following a peak in concentrations, concentrations decrease. These types of sediment profiles indicate sediment stability at most locations in a manner that corresponds with the known pattern of industrial activity in the BCSA. In addition, the Phase 2 sediment program is designed to provide a substantially increased characterization of the vertical profile of COPCs. For example, the Phase 2 high-resolution sediment coring program includes a provision for sampling and potential analysis of sediments in the 1-2 m horizon. The conditions that may lead to a decision to analyze sediments in these horizons are described in the Work Plan and include the following: (i) failure to capture the 1963 ^{137}Cs peak in the 0-1 m horizon, (ii) imprecise radiological datasets in the 0-1 m horizon (if obtaining deeper data points will decrease uncertainty in the analysis), or (iii) erratic COPC distributions (again, where deeper data points will decrease uncertainty in the analysis).

233. <u>Appendix O "Overall Interpretation of Lower Berry Creek" First Paragraph</u>: The report states that the center channel is "near a state of siltation equilibrium." However, the two cores used as examples (108 and 115) more likely illustrate a net-erosional locations.

Response: Please refer to the response to Comment #8 regarding characterization of depositional environment. TBZ-108 is interpreted as being slowly depositional (likely close to equilibrium) based on several lines of evidence, including ^{137}Cs and ^{210}Pb signatures that indicate rates of deposition that are in reasonable agreement (in light of measurement error) as well as detected ^{7}Be. TBZ-115, in a thalweg pool, is interpreted as no net change. Based on the ancillary lines of evidence discussed in the response to Comment #8, there is no evidence to suggest that these areas are net erosional. Comments regarding interpretation of geochronology data will be evaluated further during the Phase 2 data analysis and presentation.

234. <u>Appendix O "Overall Interpretation of Lower Berry Creek" Second Paragraph</u>: The report states that Lower Berry's Creek has a relatively "higher sedimentation rate." However, the core that used as an example (101) is not datable since pre-1950 material (non-detected Cs-137) was placed on top of post-1950 material (Cs-137 bearing) indicating a physical discontinuity in the core.

Response: Based on the subsurface sediment profiling conducted nearly continuously along the entire length of all four study segments, the post-Pleistocene sediment thickness in LBC is clearly the greatest. The diversion of most freshwater and tidal flow from LBC following construction of the canal in 1911 reduced stream competence (power) and capacity of LBC, resulting in conditions favorable to net deposition. Also, the deposition of landfill debris along most of LBC during the 1950s, 1960s and 1970s likely complicated the depositional profile in various ways. Such known factual events must be taken into account when interpreting the sediment cores.

Non-detect results for ^{137}Cs do not automatically indicate that the associated sediment was deposited before 1954. Theoretical and observed profiles of ^{137}Cs, such as in Zapata (2002), show that deposited ^{137}Cs activities decrease steadily in more recent time. Hence, we would suspect that shallow samples, assuming they represent recent sediment, would have relatively low ^{137}Cs. Additionally, the highest sand fraction observed in the core was found in the 0-10 cm horizon of this core; as ^{137}Cs does not strongly sorb to sand, sediment grain size may have contributed to the non-detect result for ^{137}Cs in this sample.

Following completion of Phase 2, a more substantial vertical characterization of sediments will be available to understand the general patterns and localized variations, to the extent needed to calculate risks and evaluate remedial alternatives. These results will be discussed further in the Phase 2 report.

235. *<u>Appendix O "Overall Interpretation of Lower Berry Creek" Third Paragraph</u>: The report states that the mudflats have higher sedimentation rates than the channel. However, the two cores that they use as examples (116 and 117) are not datable since pre-1950 material (non-detected Cs-137) was placed on top of post-1950 material (Cs-137 bearing), which indicates a physical discontinuity in the core.*

Response: Please refer to the response to Comment #234 regarding dating of cores with non-detect ^{137}Cs results. TBZ-115, TBZ-116, and TBZ-117 present a coherent picture of the morphological history of the associated transect across LBC. Appendix O of the Phase 1 Report (Attachment O-1) describes the relationships among the three cores in detail. To summarize, TBZ-115 represents the oldest portion of the sediment column, TBZ-116 represent sediments of intermediate age, and TBZ-117 represents the youngest sediments. Multiple lines of evidence, including COPC distributions, reasonably concurring ^{137}Cs and ^{210}Pb deposition rates, and the environmental setting of these coring locations, support that the thalweg may experience no net deposition. However, significant deposition may occur on mudflats, as evidenced by calculated deposition rates for TBZ-116 and TBZ-117 ranging from 0.9 to 2.2 cm/yr. This observation is consistent with the substantially reduced flows (i.e., stream power) in LBC since the construction of Berry's Creek Canal in 1911. Comments regarding interpretation of geochronology data will be considered further during the Phase 2 data analysis and presentation.

236. *It is noted that ^{137}Cs activity in a core was shown to have anomalies from storm activity and fine grained material had different activity than coarse grained material (Chmura and Kosters 1994). Were anomalous storm deposits identified in any of the cores?*

Response: Identification of storm deposits is not a specific objective of the Phase 1 or Phase 2 sediment program. Grain size analysis was completed for 10 cm sample intervals during Phase 1; however, much higher resolution analysis would be required to characterize deposits from individual storm events. Additional grain size data will be collected in Phase 2, but not at sufficient spatial or vertical resolution to conclusively identify specific storm-related deposits.

The Group recognizes that grain size may influence the measured radionuclide activity (i.e., sand typically has a lower activity than finer grained sediments). This was generally noted in the introduction (Appendix O, page 2-2) and specifically discussed for several of the Phase 1 cores (e.g., TBZ-127, TBZ-142, TBZ-169, etc.). All potential explanations for the observation of ^{137}Cs non-detect values, including both grain size and storm-related deposition, will be considered during the analysis of Phase 2 geochronology data.

237. The existence of a subsurface peak shows that not all the sediment deposited since 1963 has been scoured away, but some of it may have been, i.e., contamination may have been remobilized. To assess uncertainty, visual inspections of the cores should be used to look for evidence of scour (e.g., discontinuities in color or texture). Also the computed sediment fluxes based on core deposition rates should be compared with those based on runoff modeling and TSS data at the Hackensack confluence.

Response: A major objective of the Phase 2 field work and data analysis is to use all of the data, the understanding of the physical system, and the history of events in the BCSA to develop an in-depth empirical understanding of the sediment transport, deposition and resuspension dynamics. Included in this analysis will be detailed evaluation of the cores collected during the scoping, Phase 1 and Phase 2 work, as well as the sediment profile imaging work.

238. p. 2-3: The list of cores with no net deposition currently includes 5 cores (115, 127, 141, 159, and 169), but should also include 128 according to its description in Attachment O-1. 108, 142, and 149 (Cs all ND below the top 2 samples) seem to have very little deposition, if any, and should be mentioned here as well (in 108, ^{137}Cs horizon is at about 15 cm depth, but PCB concentrations are around 0.1 to 1 ppm prior to that, so there's no clear pattern of burial).

Response: The data presentations for TBZ-128 in Appendix O were in error. The corrected ^{137}Cs dataset, which was shown in Figure O-2 and elsewhere in Appendix O and the report, indicates detected values and a coherent record of sediment deposition. The geochronology findings will be further evaluated as part of the Phase 2 analysis and the corrected core profiles for TBZ-128 will be provided as part of the Phase 2 report.

For TBZ-108, TBZ-142, and TBZ-149, it is recognized that in each case, the column of recently deposited sediment is thin and overlies sediments that may be much older. Yet, in all three cases, two separate lines of evidence (^{137}Cs and ^{210}Pb dating) indicate positive rates of deposition. Hence, it is not appropriate to classify these cores as experiencing no net change. Comments regarding interpretation of geochronology data will be considered further during the Phase 2 data analysis and presentation.

239. The term "dynamic" should be inserted before "equilibrium" when referring to cores or regions of the river that show recent sedimentation but no long-term trends. This will help emphasize that there are both erosional and depositional processes at work. For areas where there is not Be-7 data indicating recent deposition, what empirical evidence is there for equilibrium as opposed to net erosion? If none, then should be separated out from those that do have evidence of recent deposition (i.e., there should be an "indeterminate" or "potential *erosion" category in addition to the equilibrium and depositional categories).*

Response: Please refer to the response to Comment #8 regarding characterization of depositional environments. The Group will consider this comment and the terminology used to characterize each sample location based on a review of the combined Phase 1 and Phase 2 geochronology data in the context of other lines of evidence related to sediment deposition. A detailed discussion of sediment deposition in the BCSA will be included in the Phase 2 Report.

240. Some cores that are depositional long term based on Cs and Pb data have no recent sedimentation judging by Be. These should also be identified as a separate category if the model is to be used for predictions and not just for a conceptual model of previous transport, because as sediment accumulates, deposition rates may decrease, so past conditions do not necessarily represent the future. So in total, there should be four categories:

- *a. Depositional (multiple lines of radioisotope/COPC evidence showing both long-term and recent deposition)*
- *b. Dynamic equilibrium (recent sedimentation, as evidenced by Be, but no long-term trends in COPCs/Cs/Pb)*
- *c. Previously depositional (long-term trends, evidenced by COPCs/Cs/Pb, but no Be evidence of recent sedimentation)*
- *d. Indeterminate, potential scour regions (no long-term trends, no recent sedimentation)*

Response: Please refer to the response to Comment #239 regarding terminology for characterizing depositional environments.

241. For cores without Be-7 data (e.g., 130, 159), will that data be coming in? If not, please explain what happened?

Response: ^{7}Be data for most cores were collected using box coring methods due to the high sample integrity that this method provides. However, the box core could not be successfully deployed in all locations due to difficulties associated with uneven sediment surfaces or a particularly stiff sediment matrix in some cases. In cases in which the box core could not be used, ^{7}Be sampling was deferred to the vibracoring program. In two such locations (TBZ-130 and TBZ-159), the core condition suggested that some sediment slumping probably occurred in the core in the shallowest intervals (i.e., top few cm). Due to uncertainty regarding the physical integrity of the top 6 cm, ^{7}Be sampling was not pursued further for these two locations. Hence, no data are pending for these cores.

242. Core 139 Pb doesn't look like a trend. The range of sedimentation rates is estimated to be quite broad (2.6 to 21.9 cm/yr) so many different things might have been happening there. Be indicates recent sedimentation, so this one should be placed in the dynamic equilibrium category.

Response: Please refer to the response to Comment #239 regarding terminology for characterizing depositional environments.

243. The description of the coring work should include a discussion of how coring locations were selected and what these represent (i.e., present the rationale behind the number of cores and their placement). When analyzing the results, it would be helpful to discuss all the deep pool samples together and all the mudflat samples together, in order to help identify any trends. This would be useful in places like Section 2.1.4.3 in Phase 1 Report and Appendix O and especially moving forward into the Phase 2 work.

Response: Please refer to the response to Comment #14 and the Phase 1 Work Plan (Geosyntec, 2009) for information regarding sediment sampling program design. The Group will consider this comment during analysis of the combined Phase 1 and Phase 2 geochronology dataset. A detailed discussion of sediment deposition patterns in the BCSA will be included in the Phase 2 Report.

Appendix P - Addendum to Technical Memorandum Regarding Identification of Candidate Reference Areas

244. The Mill Creek Reference area contains mitigation sites where major changes to the wetlands had been made in 1988 (63 acres) and more recently in 2000 (140 acres). The following information taken from http://www.njmeadowlands.gov/environment/parks/mcm.html should be included in the discussion: "This 209-acre area was purchased by NJMC for preservation in 1996 from Hartz Mountain Industries. It was undeveloped and had experienced no direct industrial activities. A development of a 2,750 town homes had been proposed for the site. It had a dense monoculture of common reed (Phragmites autralis,) with very little open water and reduced tidal flow. In its former condition, there was little habitat diversity.

Response: Additional information on the history of the wetlands mitigation work at the Mill Creek reference area will be included in the RI report and other deliverables, where appropriate.

245. In 1998, NJMC began wetlands enhancement activities at the site, including the re-establishment of tidal flows, creation of open water impoundments, grading to create low, high and upland marsh areas, and native replantings to attract a diversity of aquatic life and birds. It was the first wetlands enhancement project NJMC managed… "In 1999, the New Jersey Meadowlands Commission acquired 63 acres of the site known as the Western Brackish Marsh and 77 acres of the site known as the Eastern Brackish Marsh."

Response: See response to Comment #244.

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Weis, P. 2005. Contaminants in Fish of the Hackensack Meadowlands. Final Report submitted to the Meadowlands Environmental Research Institute. MDOC 2005-003 Report Appendices 1-3b Appendices 3c.

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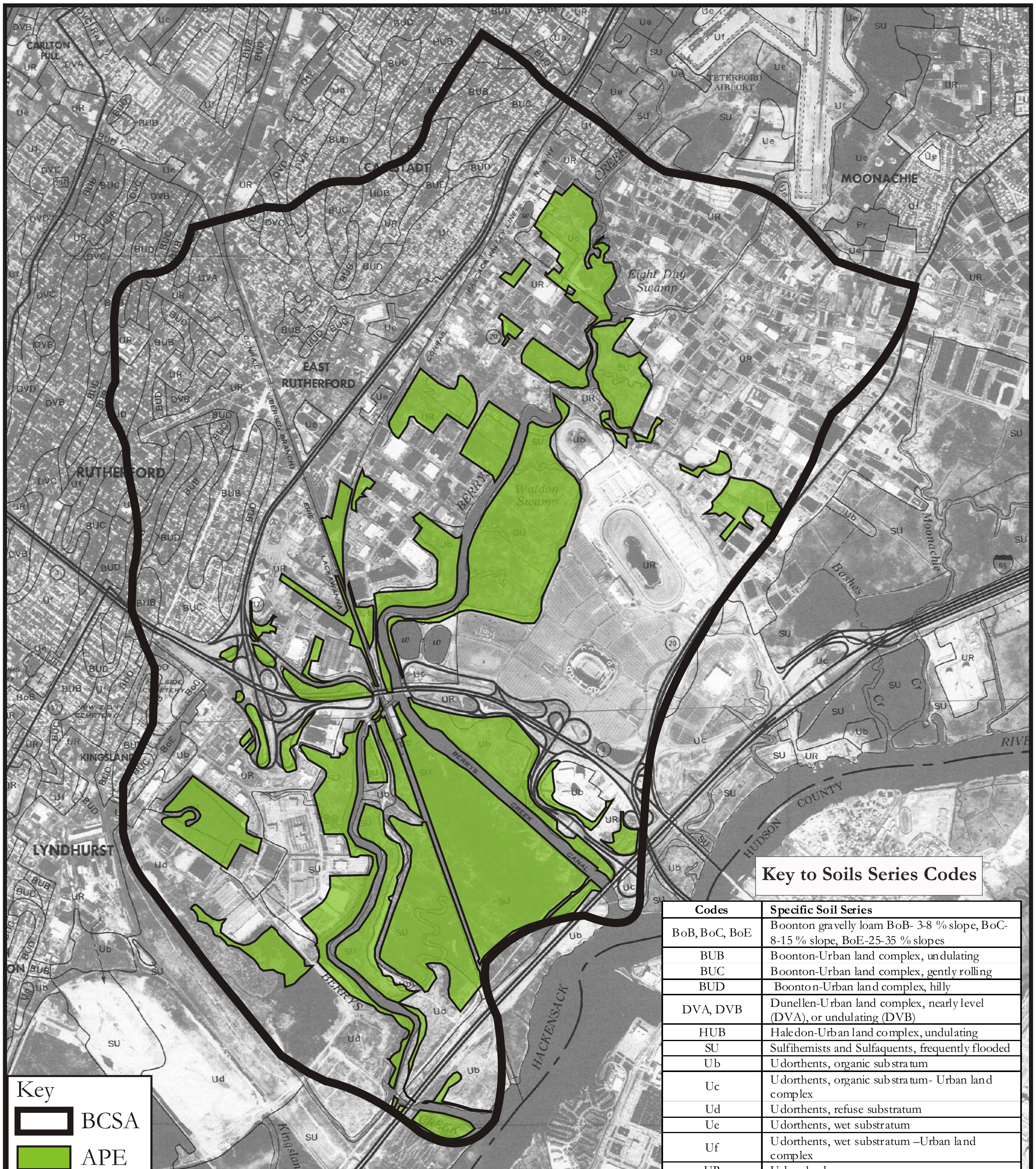
Zapata, F. (ed.) Handbook for the Assessment of Soil Erosion and Sedimentation Using Environmental Radionuclides. Dordrecht, Netherlands, Kluwer Academic Publishers, 2002. 219 pp.

ATTACHMENTS

Response to Comment #159



Codes	Specific Soil Series
BoB, BoC, BoE	Boonton gravelly loam BoB- 3-8 % slope, BoC- 8-15 % slope, BoE-25-35 % slopes
BUB	Boonton-Urban land complex, undulating
BUC	Boonton-Urban land complex, gently rolling
BUD	Boonton-Urban land complex, hilly
DVA, DVB	Dunellen-Urban land complex, nearly level (DVA), or undulating (DVB)
HUB	Haledon-Urban land complex, undulating
SU	Sulfihemists and Sulfaquents, frequently flooded
Ub	Udorthents, organic substratum
Uc	Udorthents, organic substratum- Urban land complex
Ud	Udorthents, refuse substratum
Ue	Udorthents, wet substratum
Uf	Udorthents, wet substratum –Urban land complex
UR	Urban land

Figure 3.2:

Soils Map
(from 1995 Seymour D. Goodman,
Soil Survey of Bergen County, New Jersey, Sheet Number 11).

N
W E
S
Feet
0 3000

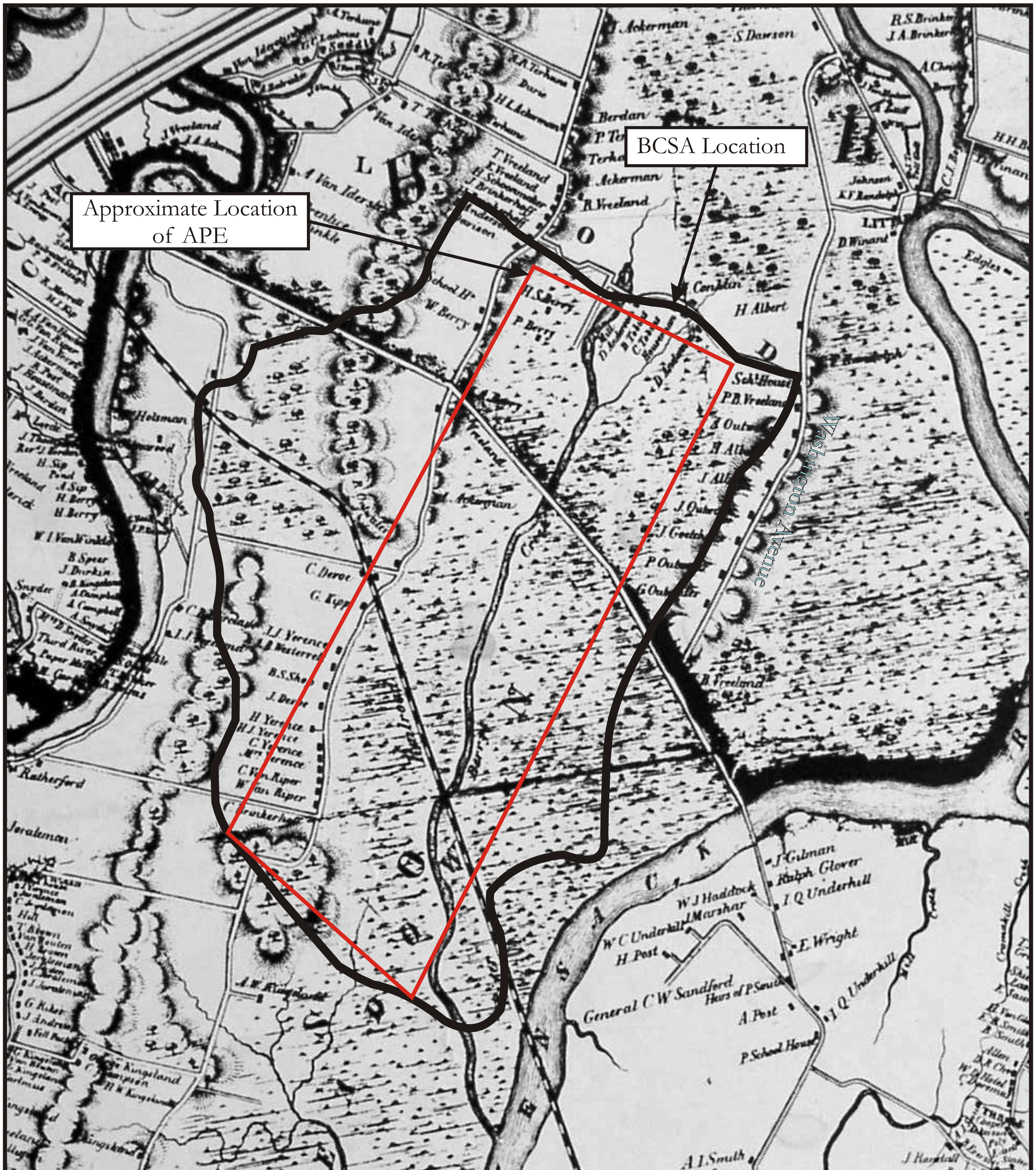


Figure 4.5:

1849 J.C. Sidney,
Sidney's Map of Twelve Miles Around New York City.

THE ELM GROUP
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December 31, 2013

-- Via E-Mail and U.S. Mail --

Mr. Douglas Tomchuk
U.S. Environmental Protection Agency
Region II
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: Berry's Creek Study Area (BCSA) Superfund Site
Response to USEPA Comments on the Phase 2 Site Characterization Report (Phase 2 Report)

Dear Mr. Tomchuk:

On behalf of the BCSA Cooperating Parties Group, The ELM Group, Inc. provides for consideration the attached responses to the USEPA comments (June 27, 2013) on the BCSA Phase 2 Report. As the Phase 2 Report will not be revised, the comments will be addressed in the RI (Phase 3) Report. In addition, these responses of comments are provided in advance of the January 8 and 9 meeting with the USEPA where initial discussion or questions of these responses will be included on the agenda.

Please contact me if you have questions or comments regarding these responses.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

PPB:ng

Enclosures

c: Gwen Zervas, NJDEP
John Hanson, Beveridge & Diamond

Attachment: Responses to USEPA Comments (June 27, 2013) On The BCSA Phase 2 Site Characterization Report Submitted 12/31/13

Below are the USEPA comments on the Phase 2 Report with a BCSA Group response following each comment.

1. Further information regarding the data treatment decisions (e.g. treatment of below detection limit data, how data were grouped and/or averaged, number of samples, whether samples collected in different seasons are grouped) should be included for the analyses presented and for those analyses that were done but not presented. It may also be useful to provide the rationale and if available, supporting data, for each relevant data treatment decision. Since work was done to come up with the best analyses, the supporting information showing why analyses conducted were not included and why the results presented were selected would be helpful. The analyses conducted but omitted could be included as a separate appendix.

RESPONSE: Additional information regarding data treatment will be included for each type of analysis presented in the Remedial Investigation Report (RI Report). The more detailed graphical, tabular, and/or statistical analyses that provide further support for the findings presented in the RI Report will be included as appendices. A variety of graphical, tabular, or statistical approaches are explored during preliminary data analysis, and many are determined to not be suitable or appropriate (e.g., inappropriate statistical tests given data distribution), or do not provide any more meaningful insight into the BCSA physical, chemical, or biological systems compared to the analyses that are presented. Substantial effort and page space would be required to provide a detailed discussion of all such analyses. In presentations to the USEPA, the BCSA Group will explain why it has selected to present the data in a particular manner. These analyses and the RI findings will be discussed with USEPA, and then if necessary, the BCSA Group will complete additional analyses using alternate approaches the USEPA puts forth.

2. While EPA believes that overall the data presentation is logical and adequate, some reviewers thought additional presentation would be helpful. Although the Phase 2 conclusions are bulleted in Section 2, the presentation and discussion of the data to support the conclusions presented could be improved. It would be useful to include comprehensive summary sampling tables for each of the geographic areas which provide the matrix sampled, number of samples, sample dates and mean, median and range of the concentrations.

RESPONSE: The requested summary tables for each study segment (LBC, BCC, MBC, UBC) and the reference areas will be included in the RI Report.

3. Mercury and methylmercury are present at elevated levels in sediment, surface water and biota in the BCSA. The most elevated concentrations are present upstream closest to the mercury source area. Total mercury concentrations, which include the relatively immobile inorganic

mercury, decrease in concentration downstream in the BCSA system. Methylmercury, which is more mobile and bioavailable, is present at more consistent concentrations from upstream (source) to downstream in the LBC. The literature generally recognizes that highest levels of mercury methylation occur in marshes that are subjected to frequent wetting and drying periods. This should be recognized and discussed. (Alpers et al. 2008; Ackerman and Eagles-Smith 2010; Foe et al 2008; Wood et al 2010; DiPasquale et al 2009).

Response: The BCSA Group agrees that: mercury and methyl mercury along with other COPCs are elevated in the upper reaches of the BCSA; the upper part of the system includes several sites that handled mercury including the Ventron Velsicol site; and the mercury concentrations generally decline moving north to south in the BCSA. Note that mercury, along with many other COPCs, had many uses and users in the past. A more detailed discussion of methyl mercury mobility is provided in the response to comment 4.

Comment 3 links patterns in the mercury data in the BCSA with certain referenced literature, stating that these are generally recognized processes, and implying therefore that wetting and drying must be an important process at work in the BCSA. However, consideration of generalizations from other sites with respect to the site-specific BCSA conditions requires detailed analysis; otherwise decisions made may not reflect site-specific factors or processes. The BCSA Group's consultant team and Technical Committee have examined the referenced papers identified in the comment. While the papers support that for sediment in certain systems, "wetting and drying periods" are a factor to be considered in methyl mercury distribution, the tidal nature of the BCSA marshes, and the high percentage of organic matter and fine particulates in the BCSA marshes, means that the BCSA sediments are always wet (saturated or a high percent moisture). The BCSA sediments and marshes do not dry like the floodplains or intermittently flooded areas studied in the cited literature. In fact, the Alpers et al. (2008) study indicates the lower elevation tidal marshes that are inundated daily, like much of BCSA, tend to have lower concentrations of methyl mercury, similar to some findings of Foe et al. (2008) and Wood et al. (2010). These findings in relation to the BCSA marshes reinforce the need for a detailed site-specific analysis of the data, and that unsupported generalizations should be avoided.

The need for and type of additional studies will be evaluated again in scoping of any additional Phase 3b studies for the 2014 field program, which the USEPA will review and approve prior to implementation. The potential relevance of wetting and drying of BCSA marshes, along with the other factors that potentially affect methyl mercury concentrations in the BCSA, will be discussed in relation to the site-specific information. The RI and FS Reports will provide a comprehensive evaluation of the multiples lines of evidence, including patterns, trends, and hydrodynamics, that must be understood to evaluate the range of site-specific remedial alternatives that should be considered in the BCSA.

4. The report acknowledges that mercury concentrations in sediment and water are highest in the UBC, and decrease downstream, with weather and tides influencing the concentrations and slope of the concentration gradient. It also acknowledges that concentrations of methylmercury do not decrease as much downstream, and there is a more equal distribution. The primary explanation in the text is that there are factors that limit the bioavailability of mercury for methylation. However, another possible reason is that methylmercury is more mobile in an aquatic system and is migrating downstream in the system from the upstream sources where mercury is at higher concentrations. This should be discussed.

Response: Downstream transport of methyl mercury in the water column is suggested in the comment as an alternate primary explanation for the distribution pattern of methyl mercury in BCSA waterways. At any one point in the BCSA there are multiple physical, chemical, and biological factors that influence the methyl mercury concentrations, and the relative influence of these factors varies over the range of conditions that occur. The Phase 2 Report recognizes these multiple factors. The report points out the relative similarity in the waterway methyl mercury levels across the BCSA study segments, despite differences in total mercury, and states that this is due to several factors including: low bioavailability of BCSA mercury due to elevated concentrations of AVS and TOC; and biogeochemical conditions (e.g., redox) in the shallow waterway sediments that limit methyl mercury production to discrete depth intervals. These are recognized in the Site-specific mercury Conceptual Site Model (CSM) (Section 2.3.7.1), In addition, the CSM states the fate and transport of mercury and methyl mercury in the BCSA are a function of both the physical characteristics of the estuary and the chemical processes described above that affect mercury form and speciation. The primary mechanisms by which mercury and methyl mercury are transported within the BCSA are movement of surface water and associated suspended sediments due to tidal action and exchange of marsh pore water due to interflow discharge and diffusive exchange.

With respect specifically to methyl mercury migration in the water column, waterway transport appears to be of relatively small importance in explaining the methyl mercury distribution in surface water from the north end to south end of the BCSA Site. Several lines of evidence support this, for example, considering the relatively high variability of hydrologic conditions from neap to spring, combined with the range of precipitation events encountered over the monitoring period, the apparently lower variability in methyl mercury concentrations along the north to south gradient would not support waterway transport as an important process at work in the BCSA. Further, the upstream portion of the study area has been shown to be highly retentive of particulates, making downstream transport an unlikely explanation of the observed pattern of methyl mercury concentrations in surface water. For these reasons, the Phase 2 report focused on differences in bioavailability and biogeochemical conditions along the gradient. Data to date support that differences in these factors are strongly controlling methyl mercury concentrations in the BCSA. For example, the sequential extraction studies done by the Group indicate that large percentages of mercury are in forms that are not bioavailable, particularly in the upper reaches. This is consistent with other lines of evidence such as the AVS-SEM data.

The Group will further evaluate, and the RI Report will fully discuss, transport and fate of COPCs, including mercury and methyl mercury. The discussion will address methyl mercury transport in the water column, using all of the relevant lines of evidence available, including factors such as the solubility of inorganic mercury and methyl mercury, the potential for downstream transport of both, methylation and demethylation, and the relatively short half-life of methyl mercury in water due to UV and biological degradation.

5. The Phase 2 Site Characterization Report includes a Regional Background Evaluation which determined the regional concentrations of the contaminants of potential concern (COPCs) in the area around the BCSA. Further information should be provided regarding how these data will be used (e.g., will they be used in the Ecological Risk Assessment).

RESPONSE: Regional background data will be used in the risk assessment along with BCSA-reference site data to support estimates of regional risks. The risk assessment will evaluate risks associated with COPCs in BCSA samples and additionally in samples collected from BCSA reference sites. Regional background data from the broader region also will be used as a point of comparison for the risks in the BCSA and the BCSA reference sites. This evaluation will be done to place site-specific risks in an appropriate regional context. This information will then be used during the evaluation of remedial objectives and alternatives, and eventually when making risk management decisions for the site. This approach is consistent with USEPA Contaminated Sediment Management Guidance.

6. In future reports, please consider adding additional cross-references to help guide the reader to other sections of the report where a topic is discussed in more detail.

RESPONSE: Comment noted. The Group will include additional cross-referencing in future report submissions.

7. Given that the *Phase 2 Site Characterization Report* describes the remedial investigation to date, it is premature to include statements that could be considered conclusions regarding the

effectiveness of specific remedial options. For example, on the second paragraph on page 1-9, under Study Question No. 4, the Phase 2 report reads "Multiple lines of evidence support the burial of COPCs by cleaner sediment is facilitating natural recovery." Statements regarding natural recovery should wait until the Feasibility Study.

RESPONSE: The Phase 2 Site Characterization Report included a detailed analysis of the horizontal and vertical distribution of COPC concentrations in sediment, as well as sediment deposition in the waterways and marshes. It is therefore appropriate to include an evaluation of these data to assess the extent to which natural recovery is occurring in the BCSA. An evaluation of Monitored Natural Recovery as a potential component of the remedy for the Site will be included in the detailed alternatives analysis and the feasibility study, as appropriate.

8. **Presentation of Averages:** Care should be taken to ensure that the development of average concentrations and their use in drawing conclusions does not bias the findings. Some examples are provided below:

RESPONSE: The RI and Baseline Risk Assessment reports will include evaluations of spatial and temporal patterns to the data. The implications of these patterns in defining the extent and risk significance of the data will be fully explored in these reports as well as the risk analysis of alternatives.

a. <u>Figure 2-38c</u>: A waterway Total PCB average concentration of approximately 68 mg/kg is indicated in the surface of MBC-Ackermans. However, when the data for MBC-Ackermans on Figure J-34 are examined, only 3 of the 11 surface waterway points (550, 122 and 37 mg/kg, respectively) have concentrations that fall above 9 mg/kg. Consequently, the average of 68 mg/kg is not indicative of the overall conditions in the surface sediment of MBC-Ackermans, yet it is being used to compare the surface conditions in MBC-Ackermans to the other presentation areas and in the development of conclusions.

RESPONSE: The comment is noted and demonstrates a drawback of the use of arithmetic averaging for potentially asymmetric datasets such as this. More refined methods of data analysis and presentation have been employed, such as the format involving data ranges in Figure 2-41. The Group has endeavored to balance the need for more detailed presentations (e.g. plots showing the results of all samples in a given reach) with the need for more simplified presentations, such as Figure 2-38c, in other cases. The latter approach has the advantage of more rapidly conveying broad lateral and vertical patterns in the data. As in the Phase 1 and Phase 2 Site Characterization Reports, the RI Report will include multiple methods of data presentation, with varying levels of complexity, to meet the varying needs for depiction of broad patterns in some cases with more detailed data presentation and analysis in other cases.

b. Table 2-4: The footnotes indicate that tabulated data represent the average of multiple sampling events (*i.e.*, Quarter 1 and Quarter 2). Please revise table to show the two sampling events separately. Also, please fix the typo in Footnote B, which suggests that all of the surface water data are unfiltered.

RESPONSE: The data presented in Table 2-4 will be presented in the RI Report and will be revised as appropriate to address the agency's comments. Please note that the footnote is correct; unfiltered surface water data were used in the comparison.

9. **Page 1-6, First Paragraph under Study Question No. 2:** Please clarify the impacts of storms on the resuspension of surface sediment. If deposition in the BCSA is estimated at 10 cm per 40 to 50 years, or 0.2 to 0.25 cm/year, then a storm that resuspends the "top few centimeters" can easily resuspended and transport sediments that had accumulated for the past 15-25 years. Please address the effects of resuspension in the BCSA on surface sediment concentrations, especially since Study Question No. 1 (second full paragraph on Page 1-6) indicated that a strong correlation exists between surface sediment concentrations and surface water concentrations normalized to suspended solids.

RESPONSE: For context, the statement in the above comment is provided below.

"The sources of stressors in relation to the receptors are better understood following Phase 2. Historical industrial discharges contributed a substantial mass of COPCs to the BCSA, including mercury, TAL metals, PCBs and other compounds. Most of the mass of COPCs is buried under layers of cleaner sediments (greater than 10 cm in most areas over the last 40 to 50 years). The top few centimeters of the surface sediments are subject to resuspension only during major storm events, such as Hurricane Irene in 2011, which had an estimated return frequency of one in eighty years. Consequently, COPCs from historic sources are largely unavailable due to physical isolation. In addition, many of the COPCs are typically associated with the inorganic fraction of sediments and suspended solids, which are highly retained in the BCSA."

The first paragraph under Study Question No. 2 (quoted above) states the high concentration COPCs from historic sources are largely unavailable due to physical isolation as only the more recent, lower concentration, sediments are resuspended, even during large storm events. The net effect of storm-related resuspension is the subject of additional evaluation, including specific sampling work in Phase 3b (2013). Nonetheless, the analysis conducted to date indicates sediment resuspension effects in the BCSA are likely minimal on surface concentrations. The resuspended BCSA sediment during storms undergoes a mixing and re-deposition process with a proportionately large influx of relatively clean sediment into the study area during storm events; from the uplands, the downstream estuary or both. This topic, including issues raised in EPA's comment, will be evaluated in detail as part of the fate and transport analysis and fully discussed in the RI Report.

10. **Page 1-6, SQ No. 2, first paragraph and page 1-9, Last Paragraph (SQ No. 4):** The report presents the finding that COPCs are associated with inorganic sediments. At many sediment sites the COPCs are proportional with the amount of organic material in sediment. Please provide supporting discussion about this finding given that it is contrary to the expected finding.

RESPONSE: The referenced text on page 1-6 was intended to convey that a large percentage of the mass of many of the COPCs (e.g., mercury, chromium, cadmium, and zinc) is present in inorganic mineral forms, such as inorganic sulfide minerals, particularly in bedded sediments. The referenced text on page 1-9 was intended to convey that, although *Phragmites* detritus from the marshes is a substantial source of organic particulate to the waterway and to the overall sediment balance, *Phragmites* detritus is low in COPC concentration and thus does not represent a substantial source of COPCs to the BCSA water column and sediments. It is acknowledged that several of the COPCs preferentially partition to organic matter and that this process must be considered in the evaluation of COPC transport and fate in the BCSA. The RI Report will provide a detailed discussion of these topics, referencing supporting data and literature where appropriate. COPC distribution within the various media (sediment, water, plant tissue, and biota) and amongst organic and inorganic fractions of these media will be discussed. The primary mechanisms that contribute to the transport, attenuation, and fate of COPCs (e.g., mineral precipitation/dissolution, partitioning, volatilization, transformation reactions) will be identified and evaluated.

11. **Page 1-11, Second Paragraph under Study Question No. 6:** Please provide data (or cross-reference an appendix or figure) to supports the following statement: "…the amount of waterway sediment redistributed during this storm event was less than the amount of sediment estimated to be deposited during…data collection (22 months)".

RESPONSE: Section 2.2.2.2 "Sediment Balance" presents the methods for determining the net sediment fluxes in the system, with supporting calculations presented in Appendix B. The cumulative fluxes show a net accumulation of inorganic sediment over the 22-month long period of measurement, including Hurricane Irene. The RI Report will include further evaluation and detailed presentation of the flux calculations, including sensitivity and uncertainty analysis on all input data and incorporation of Phase 3 data (e.g. the particulate organic carbon study, uplands runoff study).

12. **Page 1-12, Study Question No. 7:** For the Berry's Creek site, when discussing the primary CERCLA-relevant COPCs that pose unacceptable risk, it is not appropriate to just group mercury in with metals. Mercury should be explicitly named. Further, the simplicity of the study question actually warrants the listing of each of the metals that are considered COPCs at this time.

RESPONSE: The study questions have been in place and previously vetted with EPA since the RI/FS work plan was published. Their intent is to provide a broad framework by which to guide investigation and analysis. To that end, they have served their purpose, and no change is warranted. Nonetheless, it is important to note that the lack of specificity of particular metals is not intended to be exclusionary - the Phase 3 report and the baseline risk assessments will include an evaluation of all metals (as well as other COPCs) as appropriate.

13. **Page 2-3, Section 2.1, Second Paragraph, Last two sentences:** Figure 2-28 shows that dissolved oxygen concentrations are lower closer to the Hackensack River; however, results summarized on Page 2-82 indicate that organic matter concentrations are lower in the BCC and higher in UBC. Although TSS concentrations are higher in BCC, oxygen demand is usually linked to organic material. Please provide additional evaluation and explanation of the decreasing trend in dissolved oxygen concentration closer to the Hackensack River.

RESPONSE: Please see the response to Comment 50.

14. **Page 2-13, Section 2.2.1.4, First paragraph:** Please add a short description or footnote regarding the methods used during the remedial investigation to measure flow.

RESPONSE: Freshwater baseflow was directly measured in upland tributaries as described in Section 2.2.1.2.2 and SOP 1.5. In addition, freshwater baseflow was calculated based on the net seaward water flux (excluding storm water runoff inputs) measured at each of the moored stations. Integration of the calculated water flux over the 22-month long monitoring period shows, as expected, a net flow of water out of the BCSA. This flux, less the total storm water runoff (estimated based on runoff modeling; see Section 2.2.1.2.2), corresponds to the freshwater baseflow. The RI Report will include a revised water budget, including additional data collected during Phase 3. The revised water budget will include refinement of the estimate of base flow and will present the water budget for the range of flow conditions requested in comment 18.

Attachment: Responses to USEPA Comments (June 27, 2013) On The BCSA Phase 2 Site Characterization Report Submitted 12/31/13

15. **Page 2-14, Section 2.2.1.5, Second paragraph:** Several rates of evapotranspiration are referenced. Please explain how the average value of 10,725 m3/day was derived.

RESPONSE: The average value of 10,275 m3/day was estimated based on an assumed annual average evapotranspiration rate of 2.75 mm/day. This rate was selected as representative based on the range of rates cited in literature and summarized in Section 2.2.1.5. The evapotranspiration rate will be reevaluated as part of the revised water budget in the RI Report.

16. **Page 2-18, Section 2.2.1.8.1, Second paragraph:** Please define the term "depth averaged velocities" and please differentiate this term from "average velocities" as stated in the last sentence (perhaps the phrase "average velocities over time" may help). Also, it is important to know the specific bottom velocities to understand shear stress.

RESPONSE: The depth averaged velocity is an average of all of the binned velocities at specific depths from the Acoustic Doppler Current Profiler (ADCP). The average velocity is the temporally-averaged velocity magnitude over a tidal cycle. It is agreed that bottom velocities are an important consideration to understanding shear stress. In recognition of this, near bed velocities were directly measured at representative locations and morphologies during Phase 2 using near-bottom platforms, and these data related to shear stress. The bottom measurement from the ADCP profiler may be used to further investigate shear stress for the RI Report. Additionally, hydrodynamic modeling investigations are underway to evaluate shear stress throughout the system.

17. Page 2-20, Section 2.2.1.8.2, First paragraph, Second to last sentence: The *Phase 2 Site Characterization Report* states that "the larger the [storm] events are, the more they can increase the channel velocities." The relevance of this should also be clarified. For example, "…higher channel velocities have the potential to resuspend more sediments."

RESPONSE: The direct quantitative evaluation of resuspension of sediment in the waterways during storm events is ongoing with further analysis of the Phase 2 and 3 data, including cores, water column fluxes, and other lines of evaluation. These will be presented fully in the RI Report.

18. Page 2-22, Section 2.2.1.9, General Comment: A summary table presenting the range of budgets for different flow conditions would be informative to understand the water budget.

RESPONSE: The water budget will be revised based on the additional data as part of Phase 3, which will refine the uplands flow and waterway flux quantification. A tabular summary will be presented, to the extent it can be representative of the range flow conditions in the water budget evaluation. These will be presented fully in the RI Report.

19. Page 2-22, Section 2.2.2, First paragraph: The introduction to Section 2.2.2 "Sediment Transport" states that "This section focuses on incorporating the understanding of hydrodynamics … to characterize sediment transport." To assist with this understanding, please include a discussion of bottom velocities and shear stresses under different flow conditions and how that impacts sediment resuspension. (Please include a similar discussion in Section 2.2.2.3.3 "Sediment Resuspension".)

RESPONSE: The RI Report will include a revised conceptual site model of the physical system and will include data-based calculations and model predictions of bottom velocities and shear stress, and an analysis of the related implications on sediment resuspension. This will include an analysis of spatial patterns through the system over a range of conditions.

20. Page 2-26, Section 2.2.2.2, First paragraph, First sentence: Please specify what measurements (*e.g.* velocity, solids, *etc*.) are being referred to in the first sentence. For the rest of Section 2.2.2.2, please specify whether information is calculated or measured. For example, measurements and calculations are conflated in places, and in other places, it is just not clear which is being used. The appendix does not need to be repeated, but please provide the methods used for calculations and what measurements the calculations are based on. For example, Page 2-28 (Section 2.2.2.2.2, Second paragraph, First sentence) provides a specific instance where information described as measured was previously referred to as calculated.

RESPONSE: In the sediment balance provided in Section 2.2.2.2 "Sediment Balance", the methods for determining the net sediment fluxes in the system are outlined. Detailed calculations supporting the sediment flux analyses are presented in Appendix B. Further evaluation of the flux calculations, including sensitivity and uncertainty analysis on all input data and incorporation of the Phase 3 data (e.g. the particulate organic carbon study), will be presented in the RI Report. An important component, spatial variability, is being evaluated with ongoing Phase 3 studies and will be fully presented in the RI Report. These presentations in the RI Report will include greater specificity with respect to what measurements or calculations are being referenced.

21. Page 2-27, Section 2.2.2.2.1, Last paragraph, Last sentence: The conclusion made in this sentence (and the associated reference) needs elaboration and further clarification.

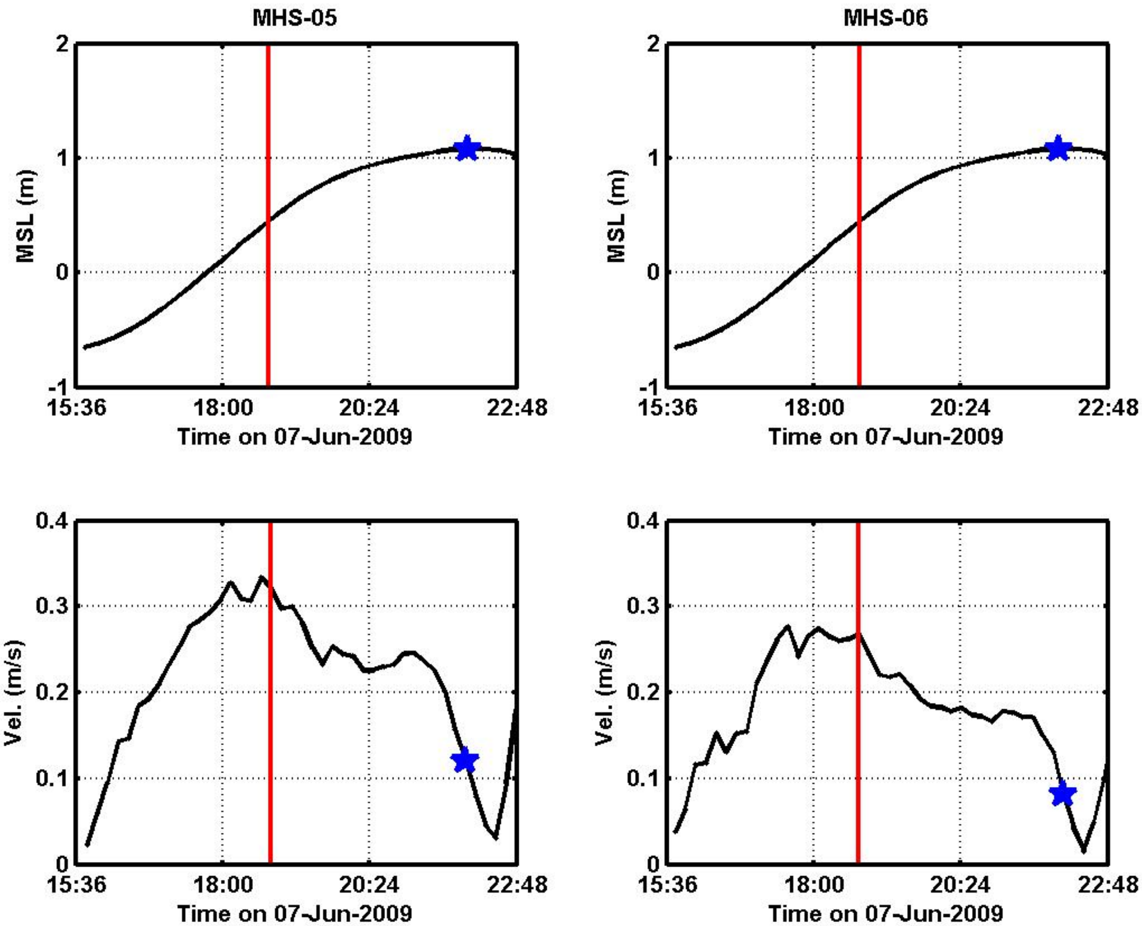
RESPONSE: The referenced sentence is as follows:

Attachment: Responses to USEPA Comments (June 27, 2013) On The BCSA Phase 2 Site Characterization Report Submitted 12/31/13

"The frequency and transport rate for the event is consistent with the general understanding of sediment transport which holds that although increased transport may occur during extreme events, it is the average conditions that govern transport in the system (Wolman and Miller, 1960)."

It is a commonly observed that channel formation is closely related to bankfull (i.e. up to the edge of the channel) flow events (Bird, 2011; Rosgen, 1996; and others). Unlike in rivers, bankfull flow occurs routinely in an estuarine wetland such as the BCSA as a result of tidal processes. Tidal bankfull flow conditions, due to their high frequency of occurrence, are thus expected to govern long-term transport in the system. This conclusion is supported by the sediment flux measurements which demonstrated that Hurricane Irene, a once in approximately 80-year event, did not cause a shift in the net sediment transport in the system measured over the 22-month monitoring period. These data show that even a very rare event does not overwhelm the dominant system dynamics.

It is also important to note that the highest tidal velocities in the channel occur when the tide reaches the bankfull elevation. As the tidal amplitude increases beyond this elevation and side tributaries and marshes begin to flood, the velocities in the channels drop as the tidal flow is spread across a greater cross sectional area. This is illustrated in the figure below, which presents measured velocities during a spring tide at stations MHS-05 and MHS-06. At a tide of 0.4 m MSL (shown as the red line in the figure), the secondary tributaries begin to flood the marsh and in-channel velocities drop even though the peak high tide (shown as the blue star in the figure) has not yet been reached. In this manner, flooding of the marshes, which also occurs during a major tidal surge event such as Hurricanes Irene and Sandy, dampens the velocities in the channel thereby reducing the bottom shear stress.



22. Page 2-28, Section, 2.2.2.2.2, Mathematical Equation: (1) The uncertainty of the numbers used in this equation should be presented; (2) Is it possible at this time to expand the "Sediment In" term to include how much material is being deposited in the marshes and how much to the open waterway?; and (3) Please clarify whether the solids input to the BSCA represents upland sources only or if it includes solids from the estuary.

RESPONSE: Section 2.2.2.2 "Sediment Balance" presents the methods used to determine the net sediment fluxes in the system, with further calculations presented in Appendix B. The sediment input to the BCSA includes both uplands and estuarine inputs. Further evaluation of the flux calculations, including sensitivity and uncertainty analysis on all input data incorporating Phase 3 data (e.g. the particulate organic carbon study), will be presented in the RI Report. An important component, spatial variability (including analysis of sediment accumulation within specific morphologic features and including marshes), is being evaluated at present with the ongoing Phase 3 studies. These analyses will be fully presented in the RI Report.

23. **Page 2-32, Section 2.2.2.3.2, Third Paragraph:** The *Phase 2 Site Characterization Report* states that "high-resolution waterway testing…demonstrated the ongoing recovery of COPCs in sediment in recent decades through continued deposition." Please quantify the reduction in concentrations. A table with average decadal concentrations per contaminant would be useful here to the discussion.

RESPONSE: The Phase 1 Site Characterization Report (BCSA Group, 2010) presented figures (e.g., Figure 2-33) that depict ratios of surface to subsurface sediment concentrations. This analysis pre-dated the high-resolution sediment core work but provides an initial assessment of the topic requested by the reviewer. The Group is evaluating refined methods of quantifying concentration reductions for various time horizons for the RI Report. However, the BCSA Group does not at this time recommend attempting quantification of average decadal concentrations; this would require the assignment of decade-by-decade age ranges to sediment core intervals across the dataset, although it can extrapolated generally. Due to the considerable variability in historical depositional patterns across the BCSA (i.e., varying depositional rates and temporal patterns thereof), the available data and associated analyses are not likely of the precision sufficient to support such assignments but will be considered further during the RI analyses of natural attenuation.

24. **Page 2-34, Section 2.2.2.3.3, Last paragraph:** This discussion on sediment resuspension should also consider shear stresses generated during Hurricane Irene (and in the future will have to compare to sheer stresses from Superstorm Sandy). If shear stresses were increased a little due to these storms, the conclusion that the deeper sediment bed would not be eroded may not hold. Please expand the discussion of analyses to summarize all locations where Sedflume cores were tested.

RESPONSE: The following presents the paragraph referenced by the above comment:

"Near-bed ADV measurements of shear stress and Sedflume measurements of critical shear stress were plotted together for in-channel (Figure 2-20a) and mudflat (Figure 2-20b) locations adjacent to MHS-07 in UBC. Figure 2-20a shows that the measured shear stress in the channel during a large spring tide exceeds the red line which represents the critical shear stress at the surface (0.19 Pa). This shows that resuspension of the fluff layer at the surface is possible at this location under spring tide conditions. The observation that the shear stress does not exceed the critical shear stress of the next depth interval tested illustrates that only the low density fluff material at the surface (on the order of millimeters thick) would be mobilized. As shown in the near-bed ADV platform data, this material

deposits back to the sediment bed as the velocities and shear stresses drop. Figure 2-20b shows that the measured shear stresses at the mudflat location are lower than the critical shear stress of the sediment bed at this location. Overall, the qualitative comparison of shear stresses at the surface of the sediment bed with Sedflume-based measurements of critical shear stress for erosion illustrates the potential for resuspension of the thin fluff layer, but not of deeper consolidated sediments."

The analyses that are the subject of this comment (comparison of ADV shear stresses, Sedflume data, flux data, etc.) represent a screening level evaluation completed to support the CSM development. This screening evaluation does not fully take into account other factors that relate to sediment resuspension. Ongoing analyses being completed as part of Phase 3 and the RI Reporting will consider factors such as:

- Shear stress distributions during different events,
- Effects of high sediment loading to the system on resuspension capacity,
- High localized shear stress related to surface water inputs,
- Reduction in channel shear stress due to high water levels (as is discussed in response to comment 21),
- Bed coarsening due to high storm-related bedload input and resulting reduction in erosion potential of the sediment bed, and
- Spatial variability in sediment properties and hydrodynamics.

Ongoing work includes an integrative analysis of multiple factors to explicitly address the transport potential of storms as related to the sediment bed and address important questions such as:

- How do the shear stresses observed and predicted compare to the Sedflume data?
- How do these data line up with measured sediment fluxes during Hurricane Irene?

Ultimately, the RI Report will include a full evaluation of the significance of storm events with respect to sediment resuspension and, in turn, COPC transport and fate.

25. **Page 2-34, Section 2.2.2.3.3 and Figure 2-20:** In Figure 2-20, the critical shear stresses provided are not the selected values for critical shear stress presented in Appendix F (which are

highlighted in blue in Table A20). In addition, when discussing Figure 2-20 in the text, please explain why the critical shear stress is higher at 3.3 cm than 5.5 cm. It would also be beneficial if more of the Sedflume data were presented in a similar manner to Figure 2-20.

RESPONSE: The comment is correct. The final critical shear stresses for core SF-10 were 0.4 Pa for both the 3.3 and 5.5 cm intervals. A revised version of the figure is attached. The final critical shear stress is higher than the reported values determined from the power law method for both intervals in Fig. 2-20. It is important to note, however, that the observations made from the figure are unchanged. As described in response to comment 24 and in response to other comments, the RI Report will present a detailed and thorough analysis of shear stress in relation to the Sedflume data.

26. **Page 2-34, Section 2.2.2.3.3, Last paragraph and Page 3-3, Last Sub-bullet (which pertains to Key Finding No. 1):** The *Phase 2 Site Characterization Report* states that "The observation that the shear stress does not exceed the critical shear stress of the next depth interval tested illustrates that only the low density fluff material at the surface (on the order of millimeters thick) would be mobilized." According to Table A19 in Appendix F, the top tested interval started at 0 cm and ended at 2.35 cm, while the next depth interval tested for this core started at 3.3 cm. Based on the information provided in the appendix, at least the top 2.35 cm of the surface would be mobilized and not just the "fluff material at the surface (on the order of millimeters thick)" as suggested in the text. (In the same context, please refer to Page 2-38 (Section 2.2.3, Second paragraph), resuspension of deeper layers does not need to be a frequent event to result in significant re-exposing/remixing of buried sediment.)

RESPONSE: The shear stress is representative of the surface of any interval. While the data are often integrated over the entire tested depth, the measurement has some bias towards the top of that interval. Additionally, because a critical shear stress is exceeded does not mean the entire layer would be quickly eroded away as erosion occurs as a rate over time. The statement made that fluff material at the surface may be mobilized is based on multiple lines of evaluation (e.g. measured sediment properties, TSS values, flux values) which show that small amounts of sediment are subject to resuspension under the vast majority of conditions. The comparison is meant to show that, at a screening level, the observations from the near bed measurements and Sedflume testing are consistent with other observations of system sediment dynamics. Resuspension and physical mixing potential through the system and across various events will be further evaluated in the RI Report considering all of the factors mentioned in the response to comment 24.

27. **Page 2-35, Section 2.2.2.3.4, "Marsh Sediment":** The last sentence in this paragraph states that unlike the results obtained in the waterway sediment layer, the vane shear test data indicate that shear strength on the marsh root sediment layer does increase consistently with depth. According to the *Waterway Sediment* section above, vane shear test data indicate that shear strength increases with depth in the waterway sediments. Please clarify which statement is correct.

RESPONSE: According to the field vane shear test measurement results, the undrained shear strength in waterway sediment samples increases with depth, whereas undrained shear strength data for marsh samples did not show an increasing trend with depth. In the RI Report, the statement will be corrected.

28. Page 2-48, Section 2.3.2.5, Bullet and footnote: Please provide a literature reference or data source on the origin of the estimated free ammonia concentration present under ambient conditions.

RESPONSE: The estimate is based on equilibrium equations and constants available in Stumm, W. and Morgan, J.J. 1996 "Aquatic Chemistry, 3rd edition" Wiley Interscience, Publishers. Table 3.2, p. 96.

29. Page 2-49, Section 2.3.2.5, Second bullet from the top: The *Phase 2 Site Characterization Report* states that "The analysis shows that for 30 to 50% or more of the monitoring period…" Based on Figure 2-28 the range would be more accurately stated as 20 to 50%. Please review and clarify as necessary. In addition, the text and Figure 2-28 do not state which dissolved oxygen threshold applies to mummichog and which to white perch. Please add this information.

RESPONSE: The text appears to be correct as written. For the four stations in southern MBC, BCC, and LBC, dissolved oxygen concentrations fall below the 5 mg/L threshold for white perch at frequencies of 30-40% (MHS-05), 40-50% (MHS-01 Shallow), >50% (MHS-01 Deep), and 40-50% (MHS-02). The footnotes of Figure 2-28 indicate the species applicability of the dissolved oxygen thresholds; these will be reflected in RI Report text as needed.

30. **Page 2-51, Section 2.3.2.7 Upland Storm Water Runoff:** The information provided in this section refers to primary and secondary COPCs. It is not clear why these contaminants are divided into these designations. This segregation should not be included in the Ecological Risk Assessment.

RESPONSE: The BERA will evaluate all chemicals that are detected above screening benchmarks. The designation of primary vs. secondary COPCs was based largely on constituents that were present in multiple media at concentrations above screening benchmarks and elevated compared to reference site levels. The purpose of this designation was to focus the discussion of site characterization data largely on the site-related constituents that would likely represent a large percentage of site-related risks. However, the discussion was not intended to be exclusionary and all compounds that are detected will be considered in the BERA.

31. **Page 2-54, Section 2.3.3.1, Marsh Well Sampling Results:** Filtered marsh water samples were compared to unfiltered surface water samples. However, for COPCs such as mercury and PCBs that adhere to particulates, filtering the marsh water samples will remove some of the COPCs. The rationale presented is that only the filtered portion is available for interflow, but the suspended material will also discharge out to the surface water (interflow). Further information should be included regarding how this relates to the conclusion that marsh interflow is not a significant source of COPCs to surface water.

RESPONSE: Unfiltered data were excluded from this analysis for the marsh well samples. Unfiltered samples have the potential to include particulate matter that are unlikely to be transported a significant distance through marsh subsurface with interflow due to the physical interaction (e.g., filtering) of particulate matter within the marsh subsurface. Therefore, marsh interflow does not represent a significant source of particulate phase COPCs to surface water. This will be explained in detail in the RI Report.

32. **Pages 2-58 through 2-66, Section 2.3.4, General Comment:** When drafting future documents, please include a summary of the types of samples obtained for reviewers that may not have lengthy experience with the project. In addition, it may be appropriate to present the findings on the biologically active zone in a separate discussion, as this zone is connected to the ecological analysis of the system.

RESPONSE: The next written deliverable will be the RI Report, which will provide the requested summary and consider the suggestions on the presentation of the biologically active zone.

33. **Page 2-59, Section 2.3.4.1, First Paragraph, and Figure 2-37:** As described in the paragraph and shown on this figure, the presentation areas for portions of MBC Ackerman and MBC Walden, as well as MBC South and MBC Walden, overlap. Please make sure that figures depicting these areas indicate clearly which area the samples are assigned to in these overlap areas, and ensure that the data are used in the conclusion for only one of the reaches.

RESPONSE: The samples in the overlap areas, which are waterway samples in MBC proper between Ackerman's Marsh and Walden Swamp, were actually used in both presentation areas (PAs). This approach was taken so that in each presentation area, its PA-specific marsh dataset is complemented by a complete waterway dataset that extends across the entire waterway, which is the case in the other PAs. It is recognized that some samples are used twice, i.e., once in each of two PAs. However, the BCSA Group determined that having a complete (full-width) waterway dataset is a greater priority. A footnote will be added along with clarification in the RI Report.

34. **Page 2-60, Section 2.3.4.2, First Paragraph, First Sentence:** The *Phase 2 Site Characterization Report* specifies the types of morphological bedforms that were sampled during the Phase 1 and 2 programs, but only specifies the depth of the sample obtained from a single bedform, that is "marshes." Please include the depths sampled from all bedforms to aid in understanding the depth of contamination. Also, please provide a cross-reference to the BAZ sampling and rationale on the selected BAZ thickness.

RESPONSE: The cited section, "Sediment Bedform Analysis," is intended to focus on the patterns of surface sediment concentrations among waterway bedforms and the marshes. An exception is the marsh data, which include both the surface (0-5 cm) and near subsurface (10-15 cm) intervals in the analyses. Hence, depths are specified for the marsh data, but not the waterway data, since the latter are limited to the BAZ in the analysis. The 10-15 cm marsh data were included in the analyses since all 0-5 cm sampling locations in the marshes have paired 10-15 cm samples.

In the waterways, the BAZ is defined as 0-10 cm in LBC, BCC, and MBC and 0-6 cm in UBC. These depths were established on the basis of an evaluation of Sediment Profile Imaging (SPI) data, as discussed in Section 2.3.1 of the Phase 1 Site Characterization Report, p. 2-39 (BCSA Group, 2010). Clarification will be added to the RI Report.

35. Page 2-60, Section 2.3.4.2, Sediment Bedform Analysis: Methylmercury is fairly consistently showing highest concentrations in intertidal samples, followed by subtidal and pool. This trend is true for all segments. This is consistent with the current understanding that mercury methylation is highest in areas subjected to wet/dry periods such as subtidal areas. This should be discussed in the text.

RESPONSE: The comment is noted, although it is not clear that this pattern prevails in all study segments. Figure 2-41, which presents methyl mercury results by bedform, indicates that the intertidal concentrations are generally higher than those of subtidal locations in UBC and portions of LBC, but the differences are not evident for MBC and BCC. Statistical population comparisons provide mixed results. While intertidal samples show statistically significant differences (higher concentrations) compared to both subtidal and pool samples in UBC and pool samples elsewhere in the BCSA, the intertidal/subtidal comparisons are more equivocal for MBC, BCC, and LBC.

The proposed mechanism explaining higher intertidal concentrations (wet/dry periods) is a potential factor that contributes to differences in methyl mercury concentrations between intertidal and subtidal zones; however, other factors, including, but not limited to, total organic carbon, sulfate, and/or sediment grain size also are likely to play a role. Also, it is assumed that the comment phrase “areas subjected to wet/dry periods such as subtidal areas” should instead conclude as “such as intertidal areas.” These processes are discussed further in the responses to Comment #3 and #4, and will be discussed in detail in the RI Report.

36. Page 2-60, Section 2.3.4.2, Sediment Bedform Analysis: The conclusion that PCB concentrations are generally higher in waterways and marshes is not clearly demonstrated on Figure 2-41. Additional data analysis should be provided to support this conclusion.

RESPONSE: Non-parametric statistical comparisons between waterway BAZ and marsh 0-5 cm samples by Presentation Area show that in eight out of 10 cases, waterway concentrations are statistically significantly higher than those of the corresponding marsh. Comparisons between waterway and marsh 10-15 cm sediments are less conclusive; however, this is to be expected, since marsh concentrations generally increase with depth. The RI Report will include additional data analyses related to this topic.

As a clarification, it is assumed that the phrase “generally higher in waterways and marshes” should be “generally higher in waterways than marshes.”

37. Page 2-63, Section 2.3.4.4, Second Paragraph/Bullet: Please indicate that the surface concentrations near Paterson Plank Creek are also elevated based on Figure J-2.

RESPONSE: The noted samples are higher than those in some tributaries (e.g., Stiletto Ditch) but also lower than clusters of BAZ points elsewhere in the PA (e.g., Eight Day Swamp Tributary, portions of UBC proper). Hence, it is not certain if the requested statement, in combination with existing narrative, is appropriately representative of PA conditions. During the preparation of the RI Report, the Group will revisit the extent to which data in small features such as Paterson Plank Creek are described.

38. Page 2-64, First Full Paragraph/Bullet: Please indicate that there are several cores that show elevated concentrations at the surface based on Figure J-4.

RESPONSE: While the comment is noted, it is also true that several cores east of Murray Hill Parkway, where higher mercury concentrations are observed, reflect peak concentrations at depth. Future narrative in the RI Report will elaborate on the discussion of the higher mercury concentrations, noting that peak concentrations are observed at the surface in some cores and at depth in other cores.

39. Page 2-66, Section 2.3.4.5, Summary of Key Findings - COPC Patterns in Sediment, Second bullet: It is indicated that more elevated concentrations of methylmercury are close to the surface in the waterways. However, Figures J-11 and J-13 summary of UBC East (and North) Group Waterway Sediment Results for Methylmercury (Graphic at upper left corner of figure) do not show highest methylmercury close to the surface in waterways as stated in the text. Additional discussion should be provided to address this discrepancy.

RESPONSE: The comment is noted, although in Figure J-13, the waterway summary graph indicates that the maximum of interval-averages occurs in the BAZ, with lower interval-averaged concentrations in the deeper sample intervals. The comment is correct in that in Figure J-11 (UBC North), the maximum interval-averaged methyl mercury concentration is in the 15-30 cm depth interval.

The justification of the report statement appears in p. 2-59, Section 2.3.4.1, in the following statement:

"Additionally, a comparison of average concentrations among sampling intervals within a presentation area shows that the highest concentrations in sediments are found at depths below the BAZ. Some exceptions to the patterns are observed, however, including the following: … and (ii) higher concentrations of methyl mercury in the waterway BAZ than in deeper intervals (also refer to Appendix D). These patterns are depicted for waterway samples in Figure 2-38 (a-c)."

The referenced bullet in Section 2.3.4.5 refers to COPC patterns that were broadly observed in the BCSA. Although there are some exceptions, the majority of the data indicate that methyl mercury concentrations tend to be higher towards the sediment surface than at depth. This is reflected in Figure 2-38b, which presents a slightly different data grouping scheme (consolidation of all data in the 6-30 cm interval, as opposed to separate averages for 6-15 cm and 15-30 cm intervals) from Figures J-11 and J-13. Figure 2-38b shows that 8 of the 10 Presentation Areas, including UBC North and UBC East, have maximum interval-average concentrations in the BAZ. Additionally, profiles of methyl mercury in high-resolution waterway cores (primarily discussed in Appendix G, Section 2.3.1) show that in almost all cases, methyl mercury concentrations increase towards the sediment surface.

40. Page 2-66, Section 2.3.4.5, Bullet List: Please add a bullet noting that that in several locations in UBS and even MBC, the highest concentrations (and some with similarly high concentrations to the peak interval) occur at the surface.

RESPONSE: The comment is noted. During the preparation of the RI Report, the Group will refine the assessment of sediment core concentration patterns with depth.

41. **Page 2-70, Section 2.3.5.3, Third paragraph:** Based on visual interpretation of the referenced figures, it appears that mercury concentrations in mummichogs from MBC and BCC and PCB concentrations in mummichogs from all BCSA reaches were higher in samples collected during the 2011 baseline monitoring program. If this is the case, such results should be referred to in the text.

RESPONSE: The RI and Baseline Risk Assessment reports will include evaluations of spatial and temporal patterns to the data. The implications of these patterns in defining the extent and risk significance of the data will be fully explored in these reports.

42. **Page 2-75, Section 2.3.5.6, Fourth paragraph:** The comparison of amphipod methyl mercury concentrations to those in *Phragmites* detritus samples is not clear, particularly because the samples were not co-located. Please clarify with additional discussion.

RESPONSE: The purpose of the comparison of methyl mercury concentrations in amphipod and detritus was to provide some perspective on potential biomagnification of mercury in amphipod compared to the surface detrital layer which they inhabit. Recognizing that the sampling was not designed specifically to quantify detritus:amphipod bioaccumulation, this point was intended for general information not definitive conclusions.

43. **Page 2-76, Section 2.3.5.7, Biota and Sediment Comparisons:** Linear or logarithmic regressions were used to compare the concentrations of COPCs in different media. A figure should be provided to illustrate the locations of specific samples used and/or excluded in each analysis area. Additionally, other factors such as comparability of the environments that impact boundaries of presentation areas and reaches should be identified.

RESPONSE: This type of information will be included in subsequent presentations and analyses.

44. **Page 2-77, Section 2.3.5.7, Biota and Sediment Comparisons:** Evaluation areas are referenced in the second paragraph of this section. It is unclear if the evaluation areas are

different from the presentation areas. This should be addressed.

RESPONSE: The term "evaluation area" and "presentation area" refer to the same area designations. Future data presentations will use a single term to identify these areas.

45. **Page 2-78, Section 2.3.5.8, Biota and Surface Water Comparisons**: In the biota and surface water comparisons it is noted that certain data were not included. Exclusion of data from analysis requires more explanation, statistical justification, and detail to understand the impact to the analysis and data bias.

RESPONSE: Future data presentations will include an accounting of data used and not used.

46. **Page2-78, Section 2.3.5.8, Biota and Surface Water Comparisons**: There were conflicting statements in the text regarding the regression analyses. It may be useful to include a summary matrix indicating what regression analyses were performed to correlate biota to sediment and surface water including filtered, nonfiltered, and DOC and lipid normalization.

RESPONSE: Tables 2-6 and 2-7 do provide a summary matrix including this information for both the sediment (MeHg, Hg, PCBs) and surface water (MeHg, Hg) regression evaluations. No regressions were developed for PCBs in fish and surface water because of the low frequency of detection of PCBs in surface water. Future data presentations will include similar summaries of results.

47. **Page 2-79, Section 2.3.5.9, Summary of Key Findings - Biota Data Assessment:** It is indicated that spatial trend with larger home ranges (white perch and blue crabs) was less apparent. This conflicts with Section 2.3.5.7 which only included species with small home ranges. Further information should be included to clarify whether any regressions on species such as white perch are limited to whole body tissue samples. Correlations of samples of less than whole body such as fillets or hepatopancreas data cannot address whole body burden or quantify uptake.

RESPONSE: COPC concentrations in wider-ranging species (any tissue) did not track with concentrations in sediments and surface water across the BCSA reaches, in contrast to patterns observed in species with smaller home ranges. Because of this, regressions of tissue to media concentrations may be insignificant in more widely ranging species and were not conducted and instead focused on those with more limited home ranges. This will be discussed in detail in the RI Report.

48. **Page 2-79, Section 2.3.5.9, Summary of Key Findings - Biota Data Assessment:** The conclusions provided should also include considerations of other factors that are known to significantly affect contaminant correlations (e.g., weight, length, and age of fish).

RESPONSE: Subsequent reports will include discussion and evaluation of other factors that can affect tissue concentrations.

49. Page 2-82, Section 2.3.6.2, First Bullet: Please caveat text since more data may be needed to determine if this pattern is still observed, especially since the methyl mercury is associated with finer or coarser particles depending on the location. Also, please discuss the trend if the dataset is analyzed as a whole instead of by reach.

RESPONSE: It is noted that the COPC fractionation dataset is limited and was not designed to support robust methods of inference, e.g., statistical hypothesis testing. Additionally, it is noted that the findings vary among locations and tidal stage. Discussion in the RI Report will be modified to note this variability.

On a system-wide basis, the following general patterns are observed: (i) at mid-flood tide mercury is approximately evenly distributed between coarse particulates and the combination of fine particulates and the dissolved phase, whereas (ii) mercury at high slack tide and methyl mercury at both mid-flood tide and high slack tide are predominantly associated with the fine particulate and dissolved phase fractions. This observation is to be expected, since mercury has a greater affinity for particulates than methyl mercury, and a greater amount of coarse particulates (e.g., flocculated organic materials of the "fluff" layer) are predicted to be in suspension at mid-flood tide (high relative channel velocities) than at high slack tide (low relative channel velocities).

50. Page 2-82, Section 2.3.6.2, Last Bullet: The text discusses an inverse relationship between TSS and organic matter. Since organic matter is linked to oxygen depletion, please include a discussion on dissolved oxygen concentrations. It would be anticipated that UBC with the higher organic matter would have lower dissolved oxygen. (However, data presented in Figure 2-28 suggest that there are lower dissolved oxygen concentrations in the BCC and in LBC.)

RESPONSE: The observed inverse relationship between TSS and organic matter appears to be is related to the tidal influx of water from the Hackensack River, which exhibits elevated biological and chemical oxygen demand (BOD, COD) due to ongoing Sewage Treatment Plant (STP) and combined sewer outfall (CSO) discharges to the River. The tidal load of BOD and COD contributes to the reduction in dissolved oxygen concentrations in BCSA and, in particular, BCC and LBC which are directly connected to the Hackensack River. The influences of STP and CSO discharges to the

Hackensack River are also evidenced by elevated surface water ammonia concentrations in the lower reaches of the BCSA. As shown in Fig. 2-27, ammonia in surface water samples collected in BCC is, on average, 2-3 times higher than that of the samples collected in UBC, which supports the above-mentioned influence of the Hackensack River. This and other factors are discussed in Section 2.3.2.5 of the Phase 2 Report. The RI Report will include an analysis of these and other regional, non-CERCLA stressors on the BCSA.

51. Page 2-86, Section 2.3.6.4, Second Bullet: Please include the word "generally" in this bulleted item.

RESPONSE: As needed in the RI Report, the text will be modified as requested.

52. **Page 2-95, Section 2.3.7.2.1, General Comment:** The discussion of the forms of organic matter is better suited to Section 2.2.2.1 "Sediment Composition." In addition, please add a discussion of the forms of inorganic matter so that the composition of sediments in the Study Area is more fully explained prior to presentation of the results.

RESPONSE: The RI Report will include a revised conceptual site model for the physical system and will include a discussion of the forms of inorganic sediment in the BCSA.

53. **Page 2-109, Section 2.4.3.1, Third paragraph, Last sentence:** Please revise to state ". . . Total biomass was *generally* highest at locations closest to the channel" because the statement does not appear to be true for UBC.

RESPONSE: The comment is noted and future discussions of marsh aboveground biomass will note that biomass was highest at the transect location 200 feet from the channel in UBC. This will be discussed in detail in the RI Report.

54. **Page 2-113, Section 2.4.6.1, Top Full Paragraph:** Although there was only one direct observation of crabbing at PPR Bridge, on several occasions field personnel (including oversight personnel) observed fresh evidence of crabbing (lines).

RESPONSE: Noted.

55. **Page 2-114, Section 2.4.7 Summary of Ecosystem Data Needs:** It is noted that the fish health will be evaluated by community metrics and condition factors. The evaluation of community metrics may be difficult. There will be a significant amount of uncertainty associated with these data.

RESPONSE: Uncertainties will be discussed in the risk assessment report.

56. **Page 2-99, Section 2.3.8 Regional Urban Background Assessment:** The details regarding the selection of sample locations within the individual reference areas should be included. Statistically valid determination of reference area concentrations requires statistically based sampling as opposed to biased sampling.

RESPONSE: Reference area sampling was conducted typically in a stratified design, consistent with the BCSA and the types of habitats (e.g. mudflat, subtidal, marsh). The data that were used to evaluate COPC concentrations in the region surrounding the BCSA were compiled from a number of different databases representing monitoring and sampling efforts by a variety of investigators and organizations with varying objectives. Because of the diversity of studies from which the data were derived, statistical hypothesis tests of the similarity or differences in COPC concentrations in the BCSA reference sites and the lower BCSA reaches were not considered appropriate and were not conducted. Instead, tabular and graphical data displays were used to evaluate similarity amongst datasets. The comparisons of BCSA RI data to the regional data was not a statistical test but rather was meant to provide an overall indication of similarity or difference of BCSA RI samples to the regional condition. The Group maintains that the approach used is sufficiently robust to provide meaningful data that can be used to place site COPC data in a regional context. Additional justification for this approach will be provided in the RI Report.

57. **Page 2-99, Section 2.3.8 Regional Urban Background Assessment:** Details on how the reference area data will be utilized in the risk assessment should also be provided. Reference area data should not be used to eliminate COPCs from the risk assessment.

RESPONSE: See response to comment 5. Reference area data will not be used to eliminate COPCs from the risk assessment.

58. **Page 2-99, Section 2.3.8 Regional Urban Background Assessment:** BCSA reference area concentrations in RI figures appear to be inconsistent with the levels depicted in Appendix S. For example, Figure 2-45 median mercury concentrations in marsh sediments in both reference and site areas are close but do not match the median levels depicted in Figure S-8 of the Appendix report. While the values graphically appear close (no values are included), in Appendix S the BCSA reference is depicted as less than the lower reaches while the RI figure shows the reverse. This discrepancy should be clarified.

RESPONSE: The difference between marsh mercury concentrations in the two figures is due to differences in the sample data depicted. In Figure 2-45, only marsh sediment samples co-located with *Phragmites* tissue samples are summarized, whereas in Figure S-8, all marsh data from all BCSA Reference sites are included.

59. **Page 2-99, Section 2.3.8 Regional Urban Background Assessment:** RI figures such as Figure 2-40 depict for comparison of site samples to reference areas/regional background maximums appear to include outliers/extremes (in part because the y-axis scale obscures the medians). However, the Appendix S report specifically indicates "Outliers/extremes generally were not used themselves as a point of comparison given that comparing them to individual points is less informative than examining the preponderance of data." Further information should be provided regarding this change.

RESPONSE: The purpose of the regional background evaluation presented in Appendix S was to evaluate comparability of COPC concentrations in BCSA reference sites and lower reaches to regional values. Given that objective, a comparison of extreme and outlier concentrations is less useful and was not done. In Figure 2-40, the purpose was to depict variability of individual sample results over space and time, and in this instance, multiple measures of regional urban background concentrations were used as relative benchmarks. Further discussion of the use of regional background data will be provided in the RI Report.

60. Page 3-2, Major Bullet (associated with Finding No. 1) and Page 3-3, Second Sub-bullet (associated with Finding No. 1): The major finding bullet states that "The transport of these sediments varies depending on the composition (organic/inorganic) of the particulates." The minor finding bullet then states that "During major precipitation events, a portion of the upland-derived sediment carried in runoff is transported into the BCSA." Please include in the list of findings (or clearly state as a known data gap) the estimated amount (or mass) of solids that are transported and the associated contaminant load on these transported solids, particularly the contaminant load on solids that are transported out of the BCSA into the Hackensack River.

RESPONSE: As is discussed in the response to comments 22 and 24, an integrative evaluation of sediment resuspension and accumulation (and associated COPC transport and fate), including analysis of Phase 3 data (including additional data on TSS and contaminants in upland runoff), is ongoing and will be presented in detail in the RI Report.

61. **Page 3-3, Major Bullet (associated with Finding No. 1):** The major findings bullet states that "Resuspension in the BCSA is limited to shallow (e.g., <1 cm) layer sediments and is typical of fringing marsh estuarine systems, except in the immediate vicinity of concentrated upland

discharges." It would also be helpful to discuss the transport and fate of such resuspended sediment.

RESPONSE: See response to comment 24.

62. **Page 3-4, Seventh Sub-bullet (associated with Finding No. 1):** The sub-bullet states that "sources of COPCS to the fluff layer likely include some redistribution of COPCs from localized areas of disturbance …" Please include in the list of findings (or clearly state as a known data gap) a description of erosional (*i.e.,* areas of disturbance) zones in the BCSA since not all of the BCSA is net depositional.

RESPONSE: As is discussed in the response to comments 22 and 24, an integrative evaluation of sediment resuspension and accumulation (and associated COPC transport and fate), including analysis of Phase 3 data, is ongoing and will be presented in detail in the RI Report. Importantly, this analysis will include an evaluation of the spatial distribution of potential sediment resuspension and accumulation patterns.

63. **Page 3-7, General Comment on "Finding No. 4":** The lines of evidence listed under Finding No. 4 are expected and are indicative of a tidal system, where tidal energy causes resuspension and redistribution of surface sediment. Please include a discussion on these topics. In addition, to better understand fate and transport of these resuspended particles. Please explain how uncertainty of the fate and transport of resuspended material is being reduced for Phase 3.

RESPONSE: See response to comments 22, 24, and 60. In addition, a more detailed and integrated analysis of the site characterization data are on-going as part of the RI fate and transport analysis. This work is expected to reduce the uncertainty of the fate and transport of resuspended material.

64. Page 3-14, General Comment on "Finding No. 10": Please qualify the statement that "there is no evidence of COPC-related adverse effects on BCSA biological communities" based on the evaluations presented in the Phase 2 report.

RESPONSE: The comment is noted. As the comment states, all findings presented in the Phase 2 report are based upon the evaluations completed as of September 2012 (the date of the report). The RI Report and BERA will provide detailed support for all conclusions related to the potential effects of COPCs on the BCSA biological communities.

65. Appendix A Task 6, Page 7: Since no spiders or amphipods were collected in Bellman's Creek in Phase 2, Phase 3 and/or 3A it may be appropriate to coordinate the sampling to ensure that it is timed with presence of these organisms.

RESPONSE: Collection of marsh invertebrates was successfully completed in the BCSA, Bellman's Creek, and Mill Creek in Phase 3A. Limited additional marsh invertebrate sampling was also completed in the BCSA in Phase 3B. These data will be presented in the RI Report.

66. Appendix B, General Comment: When ADCPs are used, there are unmeasured zones near the top and bottom of the water column. Please explain how estimates of discharge and suspended solids concentrations were made in these unmeasured zones.

RESPONSE: Velocities and TSS at the near-surface blanking distance (~0.5 to 1 m from surface) were estimated by assuming the surface measurements were equal to those measured at the top bin. Similarly, TSS within the bottom blanking distance was assumed to be equal to near-bottom measurements. Current velocities were estimated in the bottom-blanking distance using a log-profile and law of the wall.

67. Appendix B, General Comment: During the boat run cross-channel transects, it is likely that the boat did not reach the shore or areas where the water was too shallow for the ADCP to make measurements. Please explain how estimates of suspended sediment concentrations were made in these shallow areas, and how this may have affected the water and sediment balances.

RESPONSE: Near-bank blanking distance flow rates were determined from Teledyne RD Instruments estimates (trapezoidal method). TSS concentrations were not estimated across-channel. TSS estimates were made only for the location of the moored stations and assumed to be constant across a channel. Further evaluation of these assumptions will be included in the RI Report.

68. Appendix B, Page 2-5, Section 2.4.2: The regression between TSS and turbidity performed using data for all stations showed a moderate relationship. Please explain why these data were pooled together while the ABS data were analyzed for each station. Please address whether there are station-to-station differences in TSS versus Turbidity. The variability and uncertainty from this empirical formulation needs to be quantified and applied in the sediment balance.

RESPONSE: TSS was not determined from turbidity. Flux and sediment balance computations utilized ABS determined turbidity. The other parts of the comment related variability will be addressed in the RI Report.

69. Appendix B, Page 2-6, Section 2.4.2: The regression between TSS and ABS showed moderate relationships. Please quantify the uncertainty and variability in the predicted TSS. This uncertainty should be carried through the sediment balance analysis.

RESPONSE: Further evaluation of the calculations, including sensitivity and uncertainty analysis on all input data and incorporating Phase 3 data, will be presented in the RI Report.

70. Appendix B, Page 2-8, Section 2.5.1: If the Rouse equation is used to estimate w_s for the entire water column, please clarify how the bulk settling velocities (w_s) compare to the near-bed estimates.

RESPONSE: The settling velocity was not estimated for the entire water column. It was only estimated for near the sediment bed. This will be clarified in the RI Report.

71. Appendix B, Page 2-8, Section 2.5.1: The near-bed settling velocities were estimated in accordance with Fugate and Freidrichs (2002). Maa and Kwon [Estuarine, Coastal and Shelf Science 73 (2007) 351 – 354] indicated some limitation to the approach of Fugate and Freidrichs because of their assumptions and the scatter in their data sets. Please explain whether this affects the calculations in this case.

RESPONSE: Maa and Kwon (2007) outline uncertainty that is common to all field measurements of turbulent processes, including those methods applied in the BCSA. These uncertainties propagate into the calculation of settling speeds, but the trends presented in the Phase 2 report are still robust and valid for the conclusions drawn therein. Further evaluation of the calculations, including sensitivity and uncertainty analysis on all input data and incorporating Phase 3 data, will be presented in the RI Report.

72. Appendix B, Section 3, General Comment: Please quantify the uncertainty in the flux estimates for water and sediments.

RESPONSE: Further evaluation of the calculations, including sensitivity and uncertainty analysis on all input data and incorporating Phase 3 data, will be presented in the RI Report.

73. Appendix B, Page 3-1, Section 3.1: Tidal decomposition was performed by standard fast Fourier transformation. Please provide some details on the methodology, including the variance and residuals from the analysis.

RESPONSE: Fast Fourier transformation (FFT) is a standard oceanographic and engineering analysis method. Please refer to Emery and Thomson (1997) Data Analysis Methods in Physical Oceanography for details. FFT analysis was used to low-pass filter flow rate and flux time series, where the filter limit was 35-hours. Tidal decomposition (e.g., harmonic analysis to decompose a sea level time series into sinusoidal components of various tidal frequencies) was not conducted in Appendix B. Filtering of the tidal signal in the flux was done using FFT, however it is not applicable to produce variance and residuals for a standard filtering operation as it is not a correlation or regression. This will be clarified in the RI Report.

74. Appendix B, Page 3-6, Section 3.2.3.5, Third Paragraph: Please clarify whether the estimated 2,000 m^3/day of groundwater is the upper bound value based on the higher conductivities.

RESPONSE: The estimated 2,000 m^3/day of groundwater flux on the upper bound value based on the high end of the range of conductivities ($3.3x10^{-4}$ m/s) observed at the Ventron/Velsicol site.

75. Appendix F, Page 3, Section 1.2.4: Please explain the variability introduced by the methodology used to determine the critical shear stress, especially given the fact that data were averaged downcore and spatially as well. Please address how it would change depth average, and inter-site variability if the critical values were strictly limited to the estimated power, which itself is subject to the limitation in the number of points in the regression (Figure 3-1 to 3-3).

RESPONSE: In Appendix F, values of critical shear stress are presented by interval. Averages are only presented to examine general trends in particular cores and are not being used in any quantitative analysis. While there is variability among the techniques used for determination of critical shear stress, absolute measurement bounds are used, as discussed in the text, to limit variability in any regression. Variability and uncertainty will be further discussed in the RI Report as the data are applied quantitatively.

76. Appendix F, Page 5, Section 1.2.6: The report used an abbreviated version of the erosion rate equation. The report should state that one of the reasons for this abbreviation is because paired bulk density, shear stress, and erosion rates are not directly available to allow for the regression of the complete formulation. This data limitation is because sediment properties are available at discrete depths in the cores that do not correspond to depth where erosion was obtained.

RESPONSE: The text states that an abbreviated form is used because, "The variation of erosion rate with density typically cannot be determined for field sediments due to natural variation in other sediment properties (e.g. mineralogy and particle size)." Limitations of the presented analyses will be discussed in the RI Report.

77. Appendix F, Page 5, Section 1.2.6: The report states that good fits (*i.e.*, $r^2 > 0.75$) were obtained from the power law regression and used a threshold of 0.75 for acceptance of the correlation analysis. The report needs to provide a caution that the regression is not robust. In many cases there are only 2 or 3 points in the regression and this implies that the correlation coefficient is of little value. In the Tables that show the power law fits, please specify the number of points used in the regression.

RESPONSE: The BCSA Group acknowledges the uncertainty in the regression and is limited by the data provided even in the best available erosion measurements. Variability and uncertainty will be further discussed in the RI Report as the data are applied quantitatively.

78. Appendix G, Page 2-2, Third Paragraph and Page 2-3, Section 2.1.1, Third bullet: The BSCA is a highly developed urbanized area. Statements regarding PCB production at a single facility do not seem robust enough to use PCBs as a line of evidence in dating sediments. Additional research into PCB use and production in the area is warranted to support and supplement the existing discussion.

RESPONSE: The detection of PCBs provides one line of evidence for consideration in evaluating sediment deposition in the BCSA. A USEPA website on the topic of PCBs (http://www.epa.gov/wastes/hazard/tsd/pcbs/about.htm) indicates that domestic production began in 1929. Appendix G used the similar date of 1927, based on a different reference. The BCSA Group acknowledges that it is not known when, after 1929, PCBs first occurred in BCSA sediments, but the cited production history establishes an approximate earliest possible year. Estimation of the actual date of earliest occurrence requires an understanding of production history (note that no PCB production occurred in the BCSA), discharge practices, and sediment transport patterns in that timeframe, both within the BCSA and the region. This uncertainty does not diminish the value of PCB data to establish a reasonable lower bound on deposition rates when considered in the context of other lines of evidence such as geochronology.

79. Appendix G, Page 2-5, Section 2.2 and Page 2-7, Section 2.3: Please provide specific details as to how sedimentation rates for the marsh and waterway core deposition rates were calculated. A sedimentation rate utilizing the surface layer should only be calculated if Beryllium-7 (Be7) is analyzed for and detected in surface sediments. Unless Be7 is detected in the surface layer, or another appropriate tracer is available, there is no way of ascertaining the deposition year of the core top material.

RESPONSE: In the RI Report, additional narrative will be provided to explain the calculation methods in greater detail. Briefly, the calculations were performed using the following approaches:

Marsh:

- 137Cs-1963 rates were calculated as the depth from surface to peak 137Cs activity divided by the years from 1963 to collection year (i.e., 2010).

- 137Cs-1954 rates were calculated as the depth from the surface to the "horizon," i.e., the depth at which 137Cs becomes non-detect, divided by the years from 1954 to collection year (i.e., 2010). If 137Cs was detected throughout the core, then the calculation was performed using the full core depth but qualifying the result as a lower-bound deposition rate.

- 137Cs -1954-1963 rates were calculated by dividing the length separating the 137Cs peak and horizon by the 9-year timeframe between the two.

Waterways:

- The three methods described above for marsh cores were used for waterways.

- Additionally, the PCB Horizon method was used. In this approach, the depth from the sediment surface to the point at which PCBs become non-detect was divided by the years from 1927, the assumed earliest possible date of PCB presence, to the collection year (2011). Since the timing of the onset of PCB use in the BCSA is not known, it is stated that the PCB Horizon method provides a lower bound estimate of deposition rates. Refer also to the response to comment 78.

Concerning the use of the surface layer in sediment rate calculation, the caution concerning the need for 7Be data are understood. The BCSA Group agrees that if 7Be is absent from the surface, then the surface sediments may not represent 2010 or 2011 but may instead represent somewhat older sediments. The lack of 7Be in surface sediments, however, does not preclude the possibility that sediment accumulation has not occurred in the relatively recent past or that deposition is ongoing and will continue into the future. Sediment deposition in estuarine systems is a dynamic process, and the location may have reached a short-term equilibrium and/or been subject to a recent episodic event resulting in localized re-distribution of the very shallow ("fluff" layer) sediments expected to contain 7Be.

Hence, if the 137Cs peak is at a depth of 50 cm and the surface layer represents a point in time prior to 2010/2011, the average rate of deposition from 50 cm to the surface would be somewhat higher (due to shorter duration) than would be estimated using the current approach. The estimation of average deposition rate from 1963 to present using this approach is still valid, in that a net deposition of 50 cm from 1963 to present did occur, even if the rates were inconsistent over time.

80. Appendix G, Page 2-5, Section 2.2, Second Paragraph and Table G-3: The second-to-last sentence in this paragraph indicates that Cs137 was detected in the deepest sample in 7 out of the 10 cores analyzed, and Table G-3 gives sedimentation rates calculated based on the 1954 horizon for all locations. Sedimentation rates based on 1954 horizon can only be calculated if the data show a consistent pattern of non-detect results below the first instance of detection, which corresponds to 1954. If Cs137 was detected in the deepest sample of a core, then the 1954 horizon has not been located and a sedimentation rate based on it cannot be calculated. For example, the Cs137 profiles shown in Figures 3, 5, 6, 8, 9 and 10 of Attachment G-1 do not show nondetected Cs137 concentration in the core bottom. Consequently, no sedimentation rates based on 1954 horizon can be calculated for the cores shown on these figures.

RESPONSE: It is understood that without a clear 1954 horizon for 137Cs (i.e., clear transition point from detection to non-detection) it is not possible to compute a horizon-based deposition rate with precision. However, estimates of lower-bound deposition rates can still be computed of lower-bound deposition rates, i.e., by recognizing that the deposition rate is at least as great as the computed value, since the depth to horizon is at least as deep as the core depth. Such lower-bound estimates are informative, principally because they provide an additional line of evidence demonstrating the stability and natural recovery of the marsh system.

81. Attachment G-2, Figures: Review of the Cs137 profiles for the waterway high resolution cores presented in Figures 1 through 7 of Attachment G-2 indicate that deposition rate using the 1954 and 1963 horizons can only be calculated for a single core, DWC-30, shown on Figure 6. Please include an uncertainty analysis on the calculated sedimentation rates and state the limitations on the Cs137 data usability.

RESPONSE: It is assumed that the comment refers to DWC-230 as opposed to DWC-30. It is not certain if the reviewer, in the phrase "deposition rate using the 1954 and 1963 horizons can only be calculated for a single core" refers to the specific 1954-1963 rate estimate or, more generally, to estimates derived from 1954 and/or 1963 horizons (i.e., alone or jointly). Regardless, the BCSA Group generally disagrees with the comment, since all cores with the exception of DWC-211 and DWC-238 convey peak and/or horizon information that can be used to compute deposition rate estimates, even if computed as a bounding value for cases in which a peak or horizon may be present beyond the ultimate core depth.

In the RI Report, the requested uncertainty analysis will be discussed. Two general areas that will be discussed for 137Cs uncertainty are the following: (i) typical precision limits, dictated by the narrow (2-4 cm) sampling interval, and (ii) irregular, and more substantial, areas of imprecision arising from uncertain interpretations of peaks or horizons (e.g., when two potential peaks have been identified in a core that are similar in magnitude and are separated by a considerable core depth).

82. Appendix L, Page 2-1, Section 2.1, First paragraph and Table L-1: The number of perch stomachs examined for reference area fish appears to be 37 adult and 48 juvenile samples rather than 23 adult and 29 juvenile samples indicated in the text. Please explain difference in count.

RESPONSE: The counts in Table L-1 (37 adult and 48 juvenile samples) are correct. The text will be updated in the final appendix.

83. Appendix L, Page 2-2, Section 2.2.1, Second bullet: "Epifaunal species" rather than "Epibenthic species" is generally used throughout the text, tables, and figures. Please check for consistent use of such terminology throughout Appendix L (*e.g.*, epiphytic/pelagic vs. Pelagic/epiphytic vs. Epiphytic vs. Epipelagic; epibenthic crustaceans).

RESPONSE: Consistent terminologies will be incorporated in the final version of this appendix.

84. Appendix L, Page 3-4, Section 3.3.2, General Comment: Please add a discussion on the overall findings as they relate to the BCSA and reference area food webs. Please include references to the figures developed for stable isotopes.

RESPONSE: This discussion will be incorporated in the final version of this appendix.

85. Appendix L, Page 3-6, Section 3.4, Third bullet and Appendix L, Page 4-1, Section 4, Fourth bullet: The conclusion on benthic infauna/algae appears to hold true for the BCSA more than for the reference areas, particularly for benthic macroalgae/detritus. Please provide additional explanatory discussion to support conclusion.

RESPONSE: There are patterns in the carbon and sulfur isotopes in producers that help in discriminating energy flow from the base of the food web to consumers. The statement in the text about the lack of importance of benthic macroalgae/detritus is based on the detected sulfur isotope in benthic algae/detritus relative to consumers. Additional consideration of differences between the BCSA and reference areas will addressed in the RI Report.

86. Appendix L, Page 3-7, Section 3.4, Second Bullet from top: The stable isotope data are not so apparent to support this broad conclusion, although the terminology "major differences" does provide a caveat. Please provide additional explanatory discussion to support conclusion.

RESPONSE: Additional discussion of the stable isotope data will be provided in the RI Report.

87. Appendix L, Table L-2: In footnote A, GBIF 2011 and SIFP 2011 are presented twice. Please delete the extra instances. Also, footnote B appears to be incomplete. Please include the rest of the information that belongs with this footnote.

RESPONSE: These changes will be made in the final appendix.

88. Appendix M, Page 3-2, Section 3.2, First paragraph: Based on visual interpretation of the reference figures, it is not so apparent that the taxonomic groups contributing the most to densities did not vary greatly between habitats as indicated. Please provide additional explanatory discussion to support conclusion.

RESPONSE: The summary in the final appendix will include a caveat to note there was variability in upper Bellman's Creek (larger portion of polychaetes in the subtidal versus larger portion of oligochaetes in the intertidal), but that annelids in general dominated all segments across all habitats.

89. Appendix M, Page 4-1, Section 4.1, General Comment: Please add discussion of the findings across the BCSA reaches as they relate to the conclusions. Please include a conclusion regarding "... Insight on the potential utility of the benthic community as an assessment receptor in the BERA" as noted in earlier text.

RESPONSE: The BCSA Group feels the current discussion of benthic composition across BCSA in the conclusions is adequate as it discusses dominant taxa, similarity across reaches, and comparability to reference – the main focal points of this task. The revised appendix will include a brief summary on the utility of benthic community as an assessment receptor.

90. Appendix M, Table M-3: Not all of the totals appear correct. Please include a footnote stating whether the values were rounded.

RESPONSE: Yes, the values were rounded. A footnote will be included in the final appendix.

91. Appendix M, Table M-4: Consideration should be given to reordering the data presentation (*i.e.*, lower, middle, upper) to match data in Table M-3 and to facilitate comparison of the BCSA and reference site data.

RESPONSE: The suggested alternative data presentation will be considered in the final version of this appendix.

92. Appendix N, General Comment: The text in Section 1.2 suggests that taxa will be identified to Genus; however, it is noted in Section 2.2 that, where possible, marsh invertebrates were taxonomically identified to Family. Note that taxa are identified to Family in Table N-2. Please make text consistent with actual practice and provide appropriate rationale.

RESPONSE: Text in Section 1.2 of the final appendix will note that marsh invertebrates were identified to at least Family, to the extent practicable.

93. Appendix N, Page 2-1, Section 2.1, Third paragraph: It is noted that sticky cards were deployed from September through October; however, earlier text indicates that all sampling was conducted during late July through September.

RESPONSE: The third paragraph of the final Appendix will have "September through October" changed to "late July through September."

94. Appendix R, Page 3-4, Section 3.1.3, Second paragraph: Please clarify that the Regional Screening Levels are for elemental mercury. Also, please indicate in the text that the average mercury concentrations in all BCSA samples are higher than those in the reference area, if, in fact, this is the case, and that the average mercury concentration at LBC in spring and summer were higher than urban background concentrations. The USEPA's April 2012 Regional Screening Level Table should be referenced.

RESPONSE: Regional screening levels are for elemental mercury. The other requested changes will be evaluated in the context of the complete data set and if warranted included in the final version of this appendix to be included in the RI Report.

95. Appendix R, Figure R-2: Please include the USEPA Regional Screening Level on the figure since the figure is referenced in the discussion in the text.

RESPONSE: This update will be made in the final version of this appendix.

<u>Typographical Errors</u>

96. Page 2-6, Section 2.2.1.1, Second paragraph, 7th line: Please correct typo: the word "sell" should be "swell".

RESPONSE: Comment noted.

97. Page 2-29, Section 2.2.2.2.3, Second paragraph, 5th line: Please correct typo: 'vales' should be 'values'.

RESPONSE: Comment noted.

98. Page 2-35, Section 2.2.2.3.4, Fourth paragraph, Fourth line: Please correct apparent typo: '460 percent' likely should be '46 percent.'

RESPONSE: Comment noted.

99. Page 2-38, Section 2.3, Second paragraph, Third line: Please correct typo: "water column of shallow sediment" should be "water column and shallow sediment".

RESPONSE: Comment noted.

100. <u>Page 2-6, Section 2.2.1.1, Third paragraph, 5th line:</u> The conversion from m^3 to gallons is incorrect. It should not be "<u>million</u> gallons," it should just be "gallons." Please adjust.

RESPONSE: Comment noted.

101. <u>Page 2-7, Section 2.2.1.1, First line:</u> The conversion from m^3 per day to gallons per day is incorrect. It should not be "<u>million</u> gal/day", it should just be "gal/day." Please adjust.

RESPONSE: Comment noted.

Attachment: Responses to USEPA Comments (June 27, 2013) On The BCSA Phase 2 Site Characterization Report Submitted 12/31/13

102. <u>Page 2-11, Section 2.2.1.3, Table:</u> Either the conversion of the first value to gallons or the first value itself is incorrect. Please adjust.

RESPONSE: The 42 m^3/d value in the table is in error. The correct value is 1,530 m^3/d. The permitted discharge rates will be updated in the RI Report.

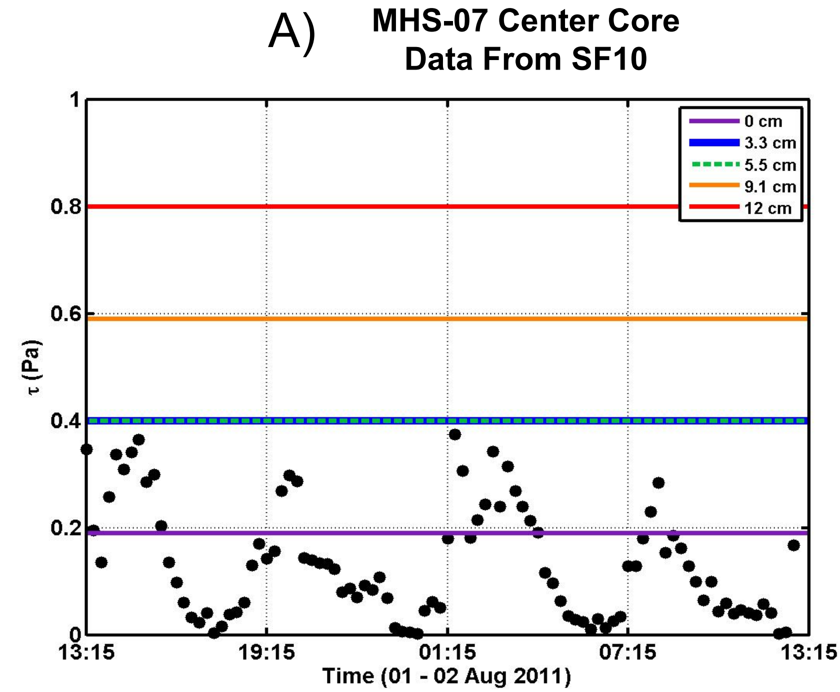
103. <u>Page 2-14, Section 2.2.1.4, Last paragraph, Last sentence:</u> The last value should be three times greater than the previous but instead it is an order of magnitude lower.

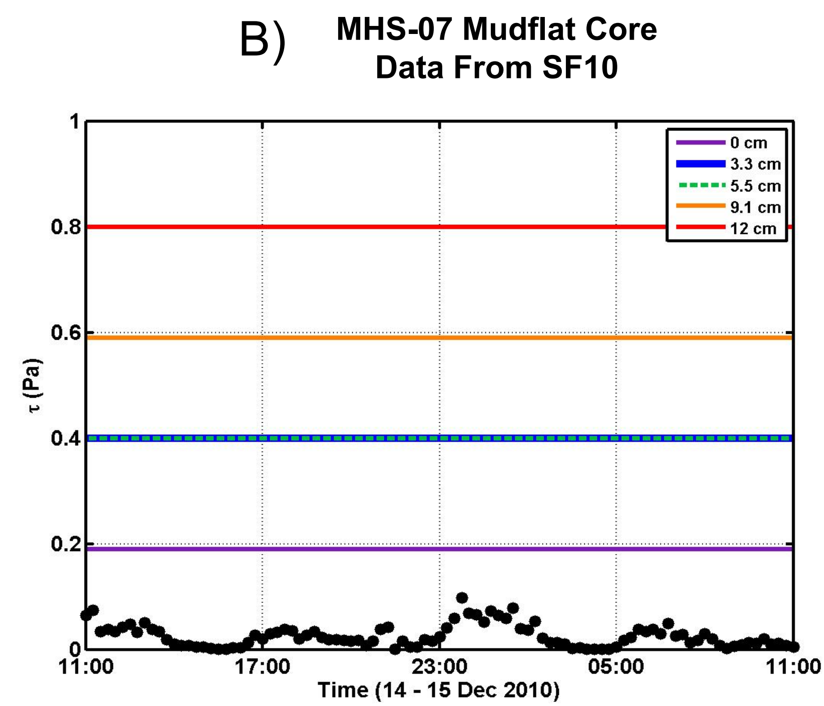
RESPONSE*:* It is assumed that this comment is referencing the following sentence: *"Based on these estimates, evapotranspiration loss from the estimated 3.9 million m^2 of marshes in the BCSA is estimated to average 10,725 m^3/day (2.8 x 10^6 gal/day) on an annual basis, and could be as high as 39,000 m^3/day (0.31 x 10^6 gal/day) during the peak summer months."* The cited value of 0.31 x 10^6 gal/day is in error. The correct value is 1.03 x 10^7 gal/day. The evapotranspiration rates will be updated in the RI Report.

<u>References:</u>

Coastal Geomorphology: An Introduction, 2nd Edition. Eric Bird. 2011. Wiley and Sons, NY, NY. ISBN: 978-1-119-96435-3

Applied river morphology. David L. Rosgen. 1996. Wildland Hydrology. University of Michigan. ISBN: 0965328902, 9780965328906





Notes:
τ = shear stress
Black dots are ADV-measured shear stress.
Lines are the critical shear stress measured from the Sedflume core at the location.
Gap in data is when the water level was below the ADV on a mudflat.

Comparison of Measured Near Bed Shear stress to Sedflume-Based Critical Shear Stress for Erosion for In Channel and Mudflat Locations Adjacent to MHS-07 (UBC)

Phase 2
Site Characterization Report
Berry's Creek Study Area

Geosyntec consultants
integral consulting inc

Figure
2-20

ENVIRONMENTAL LIABILITY MANAGEMENT, INC.

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March 13, 2009

-- Via Email and Federal Express --

Mr. Douglas Tomchuk
U. S. Environmental Protection Agency
Region II
290 Broadway, 19th Floor
New York, New York 10007-1866

RE: Berry's Creek Study Area – RI/FS – Revised Work Plan and Quality Assurance Project Plan (QAPP) Submission

Dear Mr. Tomchuk:

Provided under separate transmittal are four paper copies and one electronic copy of the revised Work Plan and QAPP for the Berry's Creek Study Area (BCSA) Remedial Investigation and Feasibility Study (RI/FS). Environmental Liability Management is submitting these documents on behalf of the BCSA Cooperating Parties PRP Group (Group) in accordance with the May 5, 2008 Administrative Settlement Agreement and Order on Consent (Settlement Agreement) for the Berry's Creek Study Area RI/FS. The Work Plan and QAPP have been prepared in accordance with Section II of the Statement of Work from the Settlement Agreement and revised based on the comments received from the USEPA on February 13, 2009, as clarified in discussions with the USEPA and other agency representatives since the submission of the draft documents on September 4, 2008. Attached is a response to each of the agency comments that is intended to indicate how the comment has been addressed and in many cases, where in the documents the corresponding revisions can be found. Further for your convenience, a paper copy and four electronic copies of the redline version of the Work Plan text has been provided. In addition, revised cover pages for the Data Management Plan and Health and Safety Plan are enclosed. No comments were provided on these documents.

The Work Plan presents the scope of work for the completion of the RI/FS. A revised rollup schedule for the entire RI/FS is provided in Section 13, emphasizing the requirements presented in the Statement of Work. As some field work is scheduled to begin in mid-April, the Group is prepared to respond quickly to any inquiries regarding the revisions to the documents.

The QAPP details the quality assurance program and includes the Field Sampling Plan (FSP) with emphasis on the Phase 1 scope of work. Results from the Methods Development Work (presented to the USEPA on January 21, 2009) have been incorporated throughout the QAPP and taken into account in the Work Plan.

If you have any questions or comments regarding these documents as they are reviewed, please do not hesitate to contact me.

Sincerely,

ENVIRONMENTAL LIABILITY MANAGEMENT, INC.

Peter P. Brussock

Peter P. Brussock Ph.D.
BCSA Project Coordinator

PPB

Attachment

c: Gwen Zervas, New Jersey Department of Environmental Protection (3 copies)
William Sy, USEPA, Edison, NJ
John Hanson, Esq., Beveridge and Diamond, P.C. (without attachments)

ATTACHMENT – March 13, 2009 Submission of Revised Work Plan and QAPP For BCSA RI/FS – Response to EPA February 13, 2009 Comments

General Comments and Draft Summary of Responses

1. The Work Plan does not currently include sediment/soil sampling in the marshes during Phase 1. This approach increases the likelihood that adequate characterization of the marshes would not be completed in three phases, thereby delaying completion of the study. Characterization of the marshes should be initiated in Phase 1, so that Phases 2 and 3 can utilize the information obtained during Phase 1 to develop appropriate programs for sampling the marshes (a.k.a., adaptive site management). The marsh sampling for Phase 1 can be timed such that it will utilize preliminary results from the sediment sampling currently planned in Phase 1 to locate the marsh sample locations.

   Response: The Work Plan has been revised to discuss a general approach and timing for marsh sampling. Specific location selections have been deferred until later in 2009 via future work session. The FSP has been updated to include marsh sampling methods, and a marsh sampling SOP has been added.

2. At our meeting in July, the importance of conducting limited sampling in the Hackensack River during Phase 1 was discussed. Given that it is currently believed that more solids enter the system from the Hackensack than from upland sources it is important to obtain information about this boundary condition at the early stages of the study. Waiting until later phases to get data from the Hackensack River would leave open many questions that could be answered with some data in hand. The data from the Hackensack would be helpful in developing later phases of sampling.

   Response: The Work Plan has been revised based on work sessions among EPA and Group representatives (see Section 4.3.5).

3. The Work Plan is noticeably inconsistent with respect to making conclusions. In general, if there is a conclusion that might suggest remediation is not necessary, such findings are included in the report. If the conclusion might suggest that remediation is necessary, then it is typically stated that it is premature to make such conclusions.

   Response: The Work Plan has been revised based on further discussions among the EPA and Group representatives.

4. Findings reported in the Work Plan are all considered tentative, and lack of comment with respect to any Work Plan finding does not mean that the finding will stand for the RI/FS.

   Response: Understood. No change required.

5. The Work Plan presents a view of the Berry's Creek Study Area that diminishes the importance of the contaminant loading from the Ventron/Velsicol, SCP and UOP sites, as well as the State listed hazardous waste sites. This gives a distorted impression of the project given the extensive industrial discharges from some of the above-mentioned sites. Acknowledgement of some of the known sources is appropriate. EPA recognizes that acknowledgement of these sources complicates discussions with respect to allocation of responsibility, but, unfortunately such complication may be necessary to describe the site background more factually.

   Response: Revisions have been made to Section 4.3.1 to clarify the source identification and evaluation process consistent with discussions with the EPA.

6. Several worksheets of the QAPP and sections of the Work Plan are presented as OPTIONS rather than DIRECTION, based on the results of the work being conducted in the Methods Development Work Plan (MDWP). Before the QAPP and the Work Plan are finalized the methods that will be used must be specified.

   Response: The final field and analytical methods have been specified in the WP and FSP, and unnecessary methods have been removed from the QAPP and SOPs.

7. A number of study questions are provided in the document to direct and focus the RI/FS. The Framework Document identified study questions for the Berry's Creek investigation. The emphasis for the questions in the Framework Document was to identify the nature and extent of chemicals of potential concern. However, the questions in this RI/FS Wok Plan have shifted to include the physical and biological stressors.

   Response: Based on discussions with EPA, no change is necessary.

8. The Executive Summary as well as the rest of the Work Plan appears to emphasize potential problems associated with biological and physical stressors. Consequently, there is some concern that any potential impacts from these stressors will be weighed heavier than the chemical contamination. The information regarding the biological and physical stressors may be more applicable in the risk management phase of the Ecological Risk Assessment.

   Response: Some revisions to the Work Plan have been made, such as additional references to support the approach and clarification of the emphasis of the Phase 1 and 2 reports.

9. Recognizing that EPA requested the integration of reporting information acquired to date

into the Work Plan, it seems that the planning document was "lost" in the rest of the report. Given that similar situations will arise with the Phase 1 Report and Phase 2 Work Plan, and the Phase 2 Report and Phase 3 Work Plan, it may be better to separate the documents in the future submissions. It will make it easier to review the tasks and approaches that will be taken in Phases 2 and 3.

Response: Agree, plans have been updated accordingly.

10. It is recognized that collecting and analyzing long sediment cores can add significant costs to the sampling programs. At the same time, collecting cores of a specified length may not always provide a sample at the bottom of native "clean" material. At this time, by only collecting 1 meter of sediment in the cores, it leaves open the possibility that additional cores may need to be collected in the future if the "bottom" of contaminated material is not included in the core.

    Response: As discussed and agreed at the USEPA meeting of January 22, the Group has selected one meter sediment cores for Phase 1. The Group understands that deeper cores may be required in Phases 2 or 3.

11. While the sampling programs do not need to characterize West Riser Ditch and East Riser Ditch in detail, it is important to be able to measure the loading from these tributaries to the BCSA. In addition, because the tide gate on West Riser Ditch is not functioning properly, contaminated solids are likely being transported upstream at this location. It is important to characterize the nature and extent of contamination that may have migrated above the West Riser tide gate, especially given the historic mercury loadings from the Ventron/Velsicol facility.

    Response: Based on previous discussions with EPA, the draft Work Plan included sampling of surface sediment at multiple locations in the Riser Ditches. The project plans have been modified to include a second sampling horizon (6 to 12 inches) at the three locations in the East and West Riser Ditch sampling locations and in Peach Island Creek. The text now discusses the basis for the 6 to 12 inch and BAZ sample increments. Additionally, we have included appropriate sampling methods for the expected sandy or gravelly matrix.

12. The study questions have become a bit convoluted. Simple questions are much more effective than overly precise, definitive (almost legalistic) language.

    Response: Based on discussions with EPA, no change is necessary.

Revisions to the Work Plan and QAPP Based on Discussions with EPA and Not Specifically Addressed in the Comments

The following is a summary of some revisions that have been incorporated into the revised documents based on discussions with EPA but not specifically in response to written comments:

- Adjustments to the distribution of sampling locations for sediment and biota have been made based on logistical considerations recognized during the Methods Development work, consideration of some recent sampling data collected as part of the Superfund work in the Middle Berry's Creek segment, and improved balance in the type of samples collected in each segment of the study area. The fundamental layout and strategy is unchanged from the September 4, 2009 Work Plan submittal.

- Dioxin sampling/analysis has been refocused to 10 BAZ samples in each of the four study area segments (see Section 8.1.3.2 of the Work Plan for a description).

- The qualitative avian survey was removed from the Phase 1 scope of work, based on discussions at the January 22, 2009 work session with the EPA and other agency representatives. Existing surveys will be utilized but may be augmented in subsequent Phases of the RI.

- The number of Aroclors that will be identified by the laboratory was increased based on consideration of the Methods Development Work.

- The contingency sediment samples were replaced by an additional sample increment in the tributary samples and some preliminary marsh sediment sampling in Phase 1, the scope of which will be determined later in 2009.

Specific Comments

1. At each sampling location, one sediment core should be collected and analyzed in a continuous fashion. Each sediment sample should be analyzed for both chemical and radiological parameters. Cores containing soft sediment should be processed in a vertical fashion.

   Response: As discussed in the work session on January 22, 2009, the number of cores at any one location will be minimized to the extent practicable taking into account 1) the amount of material required by the laboratory to complete the analysis and 2) the grouping of analytes from any one core will be based on which parameters should be analyzed from the same sample core. The text of the Work

Plan and the corresponding QAPP tables were revised accordingly.

2. The use of automatic samplers in the water column program needs to be revised. Preservation method and equilibrium time do not appear to be well developed in particular for measuring dissolved-phase constituents. These methods (along with volume requirements for low detection limits) should be revised instead of eliminating chemical class from the analytical list.

   Response: Based on subsequent discussions with EPA, the rationale for the sampling program using the automatic samplers has been clarified in the Work Plan and QAPP, recognizing that discrete grab sampling is also part of the surface water characterization program.

3. An additional DQO should be developed specifically for understanding the mercury cycle and transport in this system. This DQO should emphasize the collection of data needs and parameters (especially sampling and monitoring mercury speciation) to develop a mercury fate and transport model.

   Response: The text of the Work Plan has been reviewed and revised to relate the mercury cycle evaluation to the existing DQOs and the data needs evaluation for fate and transport assessment and modeling.

4. The Framework Document recommended the sampling of groundwater in Berry's Creek - especially in the Lower Berry's Creek area to characterize the potential leachate from the former landfills. The Work Plan discusses landfills in the site history but no sampling program was developed to investigate their impacts on the system.

   Response: The Phase 1 groundwater assessment is a paper assessment, consistent with the AOC/SOW. This work included evaluation of potential on-going sources of groundwater contamination to the tidal area. This information, along with the Phase 1 surface water and sediment data, will be used to develop a Phase 2 groundwater sampling program. No changes to the Phase 1 Work Plan were made.

5. The Framework Document recommends the sampling of Phragmites to understand the impacts of this major biomass on the system. The Work Plan discusses Phragmites and the mechanisms in the roots but no sampling program was developed to investigate their impacts on the system.

   Response: Consistent with the AOC/SOW, marsh sampling is primarily a Phase 2 site characterization activity. Phragmites have been sampled as a part of the MD

work and will be sampled as part of the Phase 2 assessment.

6. Page ES-18, first paragraph, second sentence and Page 10-2, second paragraph, third sentence – The description of "no observations" is not quite accurate. During our site tour, we walked along a path through the Phragmites that lead to the water, so there are some trails and usage of the study area. Suggest changing "no observations" to "limited observations".

   Response: Change made.

7. Page ES-24, Table ES-2 – It is recommended that the candidate reference areas and the study areas have the same data (i.e., sediment and biota) collected so that there are comparable data sets for determining how many and which reference areas are appropriate for the study.

   Response: Similar to the BCSA, the surface water, sediment, and biota (tissue) will be sampled in each of the reference areas. The text and tables have been checked for consistency.

8. Page 8-37 – It is unclear why the mummichogs and fiddler crabs will be allowed to empty their GI tract prior to sacrificing for tissue analysis while the blue crab and larger fish will not be handled in the same manner. It is more appropriate not to empty the GI tracts as the prey items that are consumed by upper-trophic level individuals will be exposed to the entire animal (i.e., tissue and GI tract).

   Response: A key focus of the Phase 1 data collection is to understand chemical bioavailability along with chemical distribution and magnitude. Residue measures in the depurated organisms provide this information for animal tissues. We recognize that these data are not necessarily representative of the exposure concentrations in the predators of mummichog or crab and that the subsequent sampling efforts might need to include collection and analysis of non-depurated organisms. The need for this type of data will be evaluated more fully during the development of the BERA work plan. Additionally, to provide some initial data on the potential differences in tissue residues between depurated and non-depurated individuals, we have modified the Phase 1 plan to include collection and analysis of non-depurated mummichogs. The text and tables in the appropriate parts of Section 8.6 of the Work Plan and in the QAPP, FSP, and SOP have been updated to reflect this addition.

9. Page 8-39 – The camera and video camera methods are novel ideas. These methods should prove very useful for documenting potential human uses. It may be beneficial to consider applying similar methods for nocturnal animal usage of the study area.

   Response: The nocturnal activity patterns of animals in the BCSA are reasonably well documented in the literature and do not require video assessment.

10. Page 10-9, last paragraph – Please add that RAGS Part D Table 1 and 4 will also be included in this deliverable.

    Response: Changes made.

11. Page 10-10, last paragraph, first sentence – Please change "and" to "or".

    Response: Changes made.

12. Page 11-9, Section 11.4.1.1 – This section contains "Seven criteria" in the title, but there are only six criteria listed in the text.

    Response: The seventh criteria has been added along with a reference to USEPA applying the remaining two criteria in accordance with the AOC/SOW.

13. Page 14-14 – The reference for Kubiak et al, 1989 is listed twice.

    Response: Change made.

14. Figure 8-7, Human Activity Observation Log – Please consider revising age groups as follows: child (0-6), adolescent (>6-18), and adult (>18) to remain consistent with age groups utilized in the risk assessment.

    Response: Change made.

15. Section 3.2.5.1 Subtasks, page 3-9 – The data usability assessment referenced a 1990 USEPA guidance document. It is not clear in looking through Section 14 that either of the two 1990 USEPA documents listed is appropriate. Please review the reference information presented. In addition, a document that could potentially be used if a statistical data quality assessment would be performed is the Data Quality Assessment: A Reviewers Guide, EPA/240/B-06/002. The EPA website, http://www.epa.gov/quality/dqa.html can be consulted for other data quality assessment tools.

Response: The referenced data usability assessment guidance remains relevant as the procedures and data evaluation process apply to the type of data that will be generated during the RI/FS. Other sources of guidance available at the EPA website have been referenced in the Work Plan.

16. Section 4.1.6 Nutrients, page 4-10 – Please clarify if the nitrogen and phosphorous are the primary parameters being considered to capture the nutrients information for the RI/FS physical stressors parameters.

    Response: Nitrogen and phosphorus are chemical stressors that have effects on the biological community, which can influence the physical system through plant growth and by altering sediment dynamics and geomorphology. Nitrogen and phosphorous can lead to eutrophication, which can depress system oxygen levels, thereby placing additional stress on the system. The discussion on page 4-10 details the relationships under consideration in the three phase site characterization. Nitrogen and phosphorus are presented as the primary parameters to capture the nutrients information for the RI/FS physical stressors; other, related parameters such as dissolved oxygen and measures of oxygen demand will be considered concurrently. The relationships are dynamic and will require additional evaluation as the data from the RI/FS is evaluated. No change made.

17. Table 6-1 Preliminary Identification of Federal and State ARARs and TBCs – It was indicated in the footnote that the sediment screening criteria were not included with the table due to the dissimilar conditions from which the criteria were generated when compared to the BCSA conditions. However, it was indicated they will still be used as part of the screening level risk evaluation. In this case, they should be included with the table. Including all the ARARs and TBCs for the project will ensure that the specifications for the methods that will be used to generate the data are appropriate.

    Response: The site-specific ARARs and TBCs should be clearly relevant to the conditions in the BCSA and; therefore, screening criteria that might be used in the screening level risk assessment do not necessarily qualify as TBCs for purposes of remedy evaluation and implementation. Multiple lines of evidence related to site-specific toxicity and risk assessment will be used to develop cleanup criteria for the BCSA. This process has been clarified in the Work Plan (see Section 6.2.1).

18. Section 8.1.2.3 Task 2C Automated Storm Event Sampling (RI-P1-T2C), page 8-19. Since this task will be using the same five automated samplers deployed to perform the automated-modified quarterly sampling (Task 2A), is there a contingency plan in place to

deploy additional automated samplers in case the storm event coincided with the 2 week sampling period for the quarterly sampling? In addition, please clarify the need to adjust the sampling start time if there is a lag between the start of the rainfall and observed hydrodynamic impacts. Aren't the four sampling events meant to capture this information for the Phase 1 field effort?

Response: Four storm sampling events of rainfall exceeding 2.5 cm are planned for Phase 1. In an average rainfall year, there are 11 such events over the course of the year; hence, we anticipate some flexibility in the selection of storm events. More generally, we view the program for automated sampling as rigorous for a Phase 1 site characterization. The interaction of the tide patterns and storm water patterns is not well understood at this point. The compilation and data reduction analysis of hydrodynamic data collected during storm conditions and non-storm conditions will be used to better understand flow patterns under varying conditions in the BCSA. Adjustments may be made to the program, in consultation with the USEPA, as the data are collected and analyzed. No additional deployment of samplers is planned for Phase 1. The subsequent Phase 2 hydrodynamic studies will be designed based on the Phase 1 data and data needs to conduct fate and transport analysis and modeling. No changes to the automated storm event sampling are necessary.

19. Section 8.1.3.3 Task 3C Transect and Core Sampling (RI-P1-T3C), page 8-27 – It is not clear from the scope of work and investigative methods description that the 53 locations for BAZ samples will include the analytical parameters listed in Table 8-4. In addition, it is also not clear if the segmentation scheme for the radiochemistry work outlined for the deep samples apply to these 53 locations as well. Table 8-4 should include the radiochemistry analysis that will be performed with this task under the analytical parameter listing.

    Response: The scope and rationale for the BAZ and core sampling have been clarified in the text and table, along with the analytical parameters.

20. Section 8.1.9.2 Data Validation, page 8-48 – The data validation approach outlined here should be revisited. As specified, performing full data validation on the Methods Development Work Plan (MDWP) samples and one batch for each of the matrices at the beginning of the Phase RI work will not be sufficient to justify a reduction in data validation going forward. A reduction in data validation should be supported by a record of acceptable performance by the laboratories. There should also be procedures or measures that would address any non-conformance during the reduced phase of data validation. In addition, what would be the data validation approach if there is a need to use the back-up or a new laboratory? Although it was indicated that the data validation

protocols are provided in the QAPP, it would be helpful if a short description of each of the different data validation tiers referenced is included in this section.

Response: The data validation approach has been revised, consistent with the discussion on January 21, 2009, to address the comment.

21. Data results should be submitted in the format compatible with the Region 2 Electronic Database Deliverable (EDD). The web site is: http://www.epa.gov/region02/superfund/medd.htm

Response: Agreed. Results will be submitted to the EPA in the format described in the Electronic Data Deliverable (EDD) Comprehensive Specification Manual V1 (United States Environmental Protection Agency. January 2008), or more recent versions as they are released. This document is contained in Appendix A of the Data Management Plan, which describes the method of data submittal. As per discussion on January 22, this will be done using email if less than 10 MB. Otherwise submissions will be via disk. The text has been revised to address the comment.

22. Was the use of field screening technologies (e.g., XRF analysis) considered? If so, please explain why such technologies were ruled out.

Response: There are a variety of difficulties in applying field screening technologies to a large site with variable field conditions (e.g. moisture content, organic carbon content, multiple chemicals of concern and accessibility issues). Until more is known of the primary chemicals of potential concern and their relationship to other chemicals of potential concern, no field screening technologies will be scoped as part of the work. Use of field screening technologies will be re-evaluated following Phase 1 and the screening level risk assessments.

23. Sect. 2.9.1.4 and Sect. 4.3.6 - The releases from landfills are said to contribute to pollutants in the BCSA, and an estimate is given of 400,000 gal/month of leachate (about 4.8 million gal/year). Wells should be installed to more directly measure the effects of leachate on ground water, which contributes to Berry's Creek.

Response: See response to specific comment #4 and Section 8.1.4 of the Work Plan. No changes necessary.

24. Sect. 8.1.2.3 - The text proposes 5-hour sample intervals for storms. Note that in urban runoff conditions, the highest concentrations of chemicals often occur near the start of the

storm (although larger volume and load can sometimes occur later).

Response: The proposed 5-hour sample intervals have been designed to ensure data are collected four times during the tidal excursion (15 hours in the BCSA); at the onset of the excursion, two points during the excursion and one point at the end of the excursion. Since tidal flow dominates during surface water runoff events and there is likely a substantial time lag between the start of a storm event and when the flow reaches into the tidal portion of the study area, the first flush effects are likely diffuse in the BCSA.

25. Sect. 8.1.4 and pg 8-59, subtask 5 - Will an inventory of all existing wells be prepared for the whole watershed? The text (Sect. 2.5) mentions that the Meadowlands area is generally considered a groundwater discharge area (see also comment #2 above). Although fresh ground water is a small component of the overall flow, it is still possible to contribute measurable contaminant loading. How is the quality of the ground water within the basin going to be evaluated and compared to surface water? It is likely that wells will need to be installed for hydraulic data and for groundwater contamination contributions. Also, how can we observe the effects of interflow (tidal waters that enter the ground and drain out after) on leaching, flushing, or contributing contaminants?

Response: The approach to the assessment of potential on-going sources (including groundwater) has been added to the text, in response to other comments and consistent with the AOC/SOW (see Section 4.3.1). No changes were made to address this particular comment.

26. In presenting some results, will profiles along the creek be prepared for chemicals in the surface water at base flow and at high tide? For example, PCB's, pesticides, and selected metals.

Response: We will evaluate the surface water data based on tidal stage and develop graphical presentations that best suit the data set.

27. It is stated on page ES-3 that aquatic ecosystems with a salinity range of 5-7 parts per thousand (ppt) typically exhibit low flora and fauna. Further information should be provided to justify this support this statement.

Response: Appropriate literature citations from the text and Appendix C have been added to the Executive summary.

28. The industrial discharges are briefly discussed on page ES-6. However, the document

should provide more details regarding the known chemical contamination associated with the creek. For example, it may be appropriate to note that it is one of the most mercury contaminated watersheds in the US. The Potential Chemical and Non-Chemical Stressors and Sources section of the Executive Summary should include contaminant information from the various Superfund sites along the creek.

Response: See response to General Comment 5.

29. Further justification should be provided regarding how the four segments (i.e., Upper Berry's Creek, Middle Berry's Creek, Berry's Creek Canal, Lower Berry's Creek) were determined.

Response: A paragraph has been added to the WP that further clarifies the technical basis for designating the four study segments.

30. The Site Setting and Background section provides a detailed description of the various sewage treatment plants. However, only a limited general description of the chemical stressor information was provided. The discussion specifically noted dissolved oxygen and salinity. Therefore, as noted previously, further information regarding the chemical contamination from the Superfund sites along the creek should be included.

Response: See response to General Comment 5.

31. On page 2-23, it is stated that "The Phragmites marshes of BCSA provide many important wetland functions. For example, they are recognized as an important and viable fish and wildlife resource (USFWS, 2007)." However, this example is taken out of context. The USFWS document did not infer or suggest that the Phragmites dominated marshes are important and viable fish and wildlife resource, rather that the Hackensack Meadowlands are important because of the significant fish and wildlife resources found there and that further losses of wetlands and open space in the Meadowlands would be expected to have an increasingly detrimental effect on fish and wildlife populations in the area. Although much of the wetland area in the Meadowlands is degraded and has a relatively low value for waterbirds, it still serves as important existing open space for migratory birds, functions as flood storage area, and retains the potential to be enhanced to more diverse and productive wetland habitat. Therefore, this example should be revised or removed.

Response: As discussed at our meeting on January 22, 2009, the text has been revised to address this comment.

32. A lengthy discussion of the benefits associated with a Phragmites marsh is included in the document. However, information regarding the problems with this mono-culture habitat should also be discussed.

    Response: As discussed at our meeting on January 22, 2009, the text has been revised to provide more of a discussion of the pros and cons of Phragmites marshes.

33. Page 2-27, it is noted that "40 percent of the migratory birds use the Meadowlands…." This notation should be changed to indicate "40% of the migratory bird species that occur in the eastern US use the Meadowlands…"

    Response: Change made.

34. Relevant ecological receptors are discussed in the document. Any endangered species should be included in the ecological risk assessment such as the American bittern (*Botaurus lentiginosus*), savannah sparrow (*Passerculus sandwichensis*) and northern harrier (*Circus cyaneus*).

    Response: As summarized by Marc Greenberg during our meeting on January 22, 2009, endangered or threatened (E/T) species are not necessarily selected as assessment receptors for Superfund ERAs, although the assessment receptors that are selected must be representative of E/T species. The assessment receptors to be selected for the site will be determined subsequently, during the problem formulation during the BERA work plan development. No change to the work plan.

35. The discussion regarding fate and transport of mercury is included on page 5-28. The discussion focused on reasons why mercury impacts could be diminished in this environment. This discussion should provide details concerning the current knowledge of the spatial extent of mercury in Berry's Creek. Additionally, further information should be included regarding how mercury biomagnifies through the food web.

    Response: The sections of the Work Plan immediately preceding page 5-28 (sections 5.3.3.1 through 5.3.3.2) discuss bioaccumulation and biomagnification of mercury. The Section that was included on page 5-28 (Section 5.3.3.3) specifically summarizes the available information for mercury in the BCSA. The data that are available suggest that some factor could be limiting methylation or bioavailability in the BCSA, but the currently available data set is incomplete and therefore the distribution of mercury in Berry's Creek or its bioaccumulation or biomagnification cannot be defined at this time. No change was made to the work plan.

36. The Great Blue heron was chosen to represent the wading bird. However, since the Great Blue heron is a migratory bird, it may be useful to also include a resident bird that breed and nest in salt marsh habitat as they would receive contaminant exposure year-round. Reproduction should be an assessment endpoint for this resident nesting bird.

Response: The assessment receptors to be selected for the Site will be determined subsequently, during the problem formulation and development of the BERA work plan development. No change to the Work Plan other than clarification that the assessment receptors will be selected after Phase 1 data analysis.

37. It is noted on page 5-47 that "Heron are avian piscivores but also consume some proportion of invertebrate prey. …..Other wading bird species known or potentially occurring in the BCSA….tend to have a diet higher in invertebrate prey than fish, and hence would have overall lower exposures (e.g., Davis, 1993; Watts, 1995)." The citations should be placed after "tend to have a diet higher in invertebrate prey than fish," and before "and hence would have overall lower exposures." These citations do not address contaminant exposures risk between different wading birds. Additionally, the type of forage (fish vs. invertebrates) consumed, although a useful indicator is not necessarily the most accurate measure of exposure as it does not measure contaminant uptake by the target receptor. Another line of evidence which can be used is to calculate a Dietary Reference Concentrations (DRC) for a variety of avian species likely to forage at or near the BCSA. This can be done, for example for methyl mercury, using an allometric (scaling) regression (Nagy, 2001; CCME, 1998) and the Canadian Tissue Residue Guidelines (CTRG) of 31 ug/kg methyl mercury (MeHg). Using this approach, the methyl mercury DRC is an order of magnitude lower in birds in the size range of wrens or blackbird as compared to a bird with a mass and diet similar to the great blue heron or double crested cormorant. Another measure of exposure is to directly measure the contaminant concentration in a tissue of toxicological relevance (i.e., bird egg, mink liver) in the target receptor.

Response: Noted. These factors can be considered during the problem formulation phase of the ERA and the subsequent development of the BERA WP. To address the agency comments on the development of assessment and measurement endpoints, text has been added in Section 5 and in Section 9 that clarifies that the information provided in this WP is an initial step that will be refined as the project moves through EPA's 8-step ERA process. Also, the text has been revised to provide more detail on how the measures of reproduction, growth, and survival will be used to estimate the risk of decreases in population abundance as part of the

baseline ecological risk assessment. Finally, text has been added that clarifies that the details of any endpoints and the assessment plan will be developed and articulated in the BERA work plan.

38. The assessment endpoints selected in the document involve maintenance of the abundance of populations. The assessment endpoints are limited to birds and mammals. Further information should be included to justify the exclusion of fish and benthic invertebrates. Additionally, measuring abundance of a receptor using bird call surveys or direct counting may be biased toward the adults of the target population. These methods may not account for the presence/absence juveniles, or earlier life stages. Unless conducted over several generations, abundance census methods cannot measure juvenile/egg mortality and are not applicable to identifying or quantifying populations that may not be successfully reproducing, and/or experiencing immunological, neurological, metabolic, or growth disorders. For the purposes of the work plan, abundance is not an appropriately sensitive endpoint for comparison to contaminant tissue concentrations. Therefore, to be protective of all potentially exposed biota, the criteria used to evaluate the potential for harmful effects should be based on more specific endpoints (e.g., reproductive, immunological, metabolic effects) to sensitive species.

    Response: See response to comment #37.

39. The work plan states "Measurement endpoints will be chemical residues in biota, surface sediments, and surface waters. The resulting concentrations will be compared with measures of toxicity." The biota selected for chemical analysis are mummichog, white perch, fiddler crab, and blue crab. It is not clear how the comparisons to toxicity will be used to estimate changes in abundance, as well as changes in abundance more than what might be seen in the reference populations. The determination of estimates of potential reductions in survival, growth, or reproduction to a population abundance estimate may be difficult. Therefore, it may be appropriate to revise these endpoints.

    Response: See response to comment #37.

40. Chemical residues in fish, crabs, sediments and water cannot be used to directly measure toxicity to fish-eating mammals and birds. This can, however, be best done by measuring chemical residues in the tissues of toxicological relevance in mammals and birds (i.e., egg, liver).

    Response: See response to comment #37.

41. It is stated on page 5-55 (Study Question 1) that, "Although the focus of stressor characterization in the RI/FS will be to understand the risks posed by CERCLA chemical stressors, information on the magnitude, distribution and effects of non-CERLA stressors that are operating in the system (e.g., dissolved oxygen depression, nutrient loading, salinity gradients) will be comparatively important for defining the nature, magnitude, and concentration-response relationships for CERCLA stressors and site receptors." Bioavailability may be affected by physical factors but these factors should not be used to define concentration-response relationships.

    Response: Noted. No change needed at this time.

42. In Study Question 2 the discussion identifies current and historical stressor sources in relation to the receptors important to defining risk. Industrial discharges and outfalls are included in the list of stressors. Further information should be included regarding how historical industrial discharges which may be still migrating to the creek will be addressed.

    Response: Revisions have been made to the text of the Work Plan (Section 4.3.1) to clarify the assessment of potentially continuing sources.

43. The questions included in Study Question 7 are, "What are the primary CERCLA-Relevant COPCs that pose unacceptable risk? How does this risk compare to effects caused by other stressors in the system? How do these risks interact with effects caused by non-chemical stressors?" As noted previously these physical stressors may be more useful in the risk management phase of the ecological risk assessment.

    Response: Agreed. In addition, the influence of physical factors or stressors on species distribution and abundance will be considered when evaluating potential toxicity relationships along gradients of chemical stressors to ensure cause-effect relationships are objectively understood.

44. Study Question 12 includes the Stakeholders (i.e., Meadowlands Commission, NJDE[P], USFWS, USACE, and local government entities) for the site. NOAA should be included in this list.

    Response: Changes made.

45. In the Phase 1 Site Characterization section there is a discussion of sediment balance which includes a reference to "baseline sediment flux." Further information should be included to explain this reference.

Response: The phrase "baseline sediment flux" does not appear in the work plan. However, "baseline" was erroneously applied in a similar context in the first paragraph of page 8-5 and has been deleted.

46. Several different water quality probe measurements are proposed and many of them at single depths. However, further information should be included regarding why these measurements will not be taken at multiple depths.

Response: Agreed. Additional detail has been provided on Pages 5-14 and 8-8 of the Work Plan.

47. Depth sensors are proposed to be placed in pans in the marshes to monitor water intrusion. Water quality meters are also proposed for the pans. It would be helpful to include an explanation of how these pans will flush well enough to provide meaningful water quality data.

Response: The marsh water quality study has been refined through preliminary field work. The pans have been replaced by discrete monitoring points along transects in the marsh (see Section 8.1.1.3). The text of the Work Plan and QAPP have been revised to reflect that change.

48. According to the Site Characterization section, sampling will be conducted to determine the most appropriate biologically active zone for sediment. It is noted on page 8-23 that it is anticipated that the biologically active zone (BAZ) in sediment will be a few centimeters in thickness over the majority of the Berry's Creek Study Area. However, the sampling depth for sediments recommended by the BTAG is 0-6 inches.

Response: Based on the work session on January 22, 2009, the text has been revised to identify a 5 to 10 cm (0-6 inches) increment fallback position if a site-specific BAZ increment can not be established in a particular area, as recommended by the National Research Council (NRC).

49. It is stated on page 8-24 that "Even at its lowest density, BAZ sampling is consistent with the home range of mummichogs, which will support comparisons between sediment and mummichog tissue concentrations of COPCs (see Section 8.1.6). As Table 8-5 and its associated graph show, the lowest spatial sampling density (identified by the highest m2 per sample) equals approximately 10,000 m2. The associated characteristic linear dimension equals 100 m, which is approximately equal to the home range of

mummichogs." This paragraph is confusing and infers that a BAZ lowest sampling density is similar to the mummichog home range and both are approximately a square hectare. Further justification should be provided regarding the 100 meter linear home range of the mummichog. Additionally, further clarification should be provided for extrapolating out to 10,000 meters^2. According to Lotrich (1975), between June and early September the home range of mummichog is 30-36 meters and confined to one stream bank. Recapture data of marked individuals indicated that mummichogs may be polytypic in its winter behavior (Fritz *et al.* 1975) and that many individuals do not leave the summer home range. Therefore, it may be appropriate to use the breeding season home range value (Lotrich 1975) as it takes into account a more complete picture of the mummichog life cycle, particularly for the use in risk assessment of the most sensitive life stages (*i.e.*, egg, larvae development), as well as chronic adult exposure. Using the Lotrich (1975) home range value and confinement to one stream bank, the proposed lowest sampling density of 10,000 meters^2 appears to underestimate the sampling site frequency/density by an order of magnitude or more and may not "support comparisons between sediment and mummichog tissue concentrations of COPCs." The BTAG is available to assist in the re-evaluation of the sampling design to ensure an appropriate spatial coverage.

Response: The rationale behind the statements related to sampling density and mummichog unit use area were clarified and connected to the literature on mummichogs, consistent with the discussion at the January 22, 2009 work session.

50. It is noted on page 8-29 that since groundwater discharge is small compared to tidal flux, the contaminant pathway through groundwater to Berry's Creek is not anticipated to be a factor. At this point in the process it may be premature to make this conclusion.

Response: The text in Section 8.1.4 has been reviewed and clarifications were made relating to this statement, including that the analysis will be further evaluated during the Phase 1 and Phase 2 work.

51. In the discussion of the biota sampling for analyses it is indicated that individuals will be composited for each sampling station within each segment. Further information should be provided regarding how the biota will be selected (i.e., size, sex) for compositing.

Response: All fish and blue crab that meet the minimum size criterion will be used in the composite sample. The size criteria are stated in the WP and in the FSP and SOPs. No additional sorting (e.g., by sex) is proposed. Therefore, this comment did not result in a change to the work plan.

52. The evaluation of reference areas is discussed on page 8-44. A list of potential reference locations is included in this evaluation. It may be appropriate to also consider other sites which may not be as contaminated (e.g., Great Bay Estuary, Saw Mill Creek) as the selected locations were from industrial areas. Additionally, further information should be included regarding how each of the reference areas proposed will be used in the overall process.

    Response: Appendix C provides a detailed analysis of the potential reference locations and addresses the comment in the context of the relevant guidance and literature. Some text from Appendix C was added to Section 8.1.8 for clarification.

53. Certain PCBs are "dioxin-like," in that they exert toxic effects similar to 2,3,7,8-tetrachloro-*p*-dibenzodioxin (TCDD), one of the most toxic substances known. TCDD and dioxin-like compounds (including polychlorinated dibenzodioxins [PCDDs], polychlorinated dibenzofurans [PCDFs], and certain PCBs) act on vertebrates in an additive fashion, regardless of the exposure concentration and route of exposure, through the same receptor mediated mechanism of action. The total dioxin-like activity is therefore typically described using "toxic equivalency factors," or TEFs. The TEF approach uses the potency of individual dioxin, furan, and PCB congeners, relative to TCDD, along with measured concentrations of these chemicals to calculate a toxic equivalent (TEQ) for each compound. Therefore, PCB aroclor analysis alone is inadequate for risk assessment. It is recommended that EPA Method 1668 (EPA 1999) for PCBs and EPA Method 1613 (EPA 1994) for dioxins and furans be used, along with a sample preparation method such as that described by Rushneck (2004) for tissue, water, sediment and soils. Further information regarding congener-specific analytical methods as applied to eggs, tissue and soil can be attained from Peterman, *et al.,* (1996).

    Response: The need for congener analysis will be considered during the development of Phase 2.

54. It should be noted that the dioxin-like TEFs are appropriately used only in conjunction with tissue concentrations; a TEQ cannot be accurately assessed from sediment concentrations, because bioavailability, uptake, and metabolism of dioxin-like compounds from sediment into tissues are not equivalent among congeners. Therefore, tissue data or an estimation of tissue concentrations using biota/sediment accumulation factors (BSAFs) and biomagnification factors (BMFs) are required to adequately evaluate dioxin-like compounds, including PCBs. It is recommended, prior to the sampling efforts, that decisions be made regarding which specific sediment samples and over what spatial distribution will be paired with specific biota samples to develop site-specific and/or reach-specific BSAFs.

Response: Based on discussions with EPA no is change needed. The suggested discussions will be part of a work session that will occur during the development of the BERA Work Plan.

55. As part of the ecological risk assessment, bird eggs (e.g., red-winged blackbird, marsh wren, clapper rail, and Canada goose) should be collected and analyzed for heavy metals, PCBs, TCDD/F, percent lipid, and organochlorine pesticides. Metal concentrations from red-winged blackbirds and marsh wrens breeding in the Hackensack Meadowlands of New Jersey were recently published (Tsipoura et al. 2008) and may be useful in designing a sampling plan.

Response: The suggestion will be considered as part of a work session that will occur during the development of the BERA Work Plan.

56. On page 9-2 the Assessment Endpoints are discussed as part of the Screening Level Ecological Risk Assessment. As noted previously the use of population abundance may not be an appropriate assessment endpoint.

Response: See response to comment #37.

57. In Appendix B the Aquatic Fauna Field Survey is discussed. Further details should be provided regarding the sampling scheme to determine if it is appropriate for a community structure analysis, and no statistical analyses are described. Based on the information provided, no long-lived, higher trophic level fish are being collected for residue analysis. Therefore, it may be appropriate to collect a higher trophic level species if present. The appropriate sampling period for tissue residue in biota is late summer when the highest methylation rates typically occur.

Response: The aquatic community survey will provide data to determine if higher trophic level fish are present for consideration in the BERA. The survey is being conducted to determine the general composition of the aquatic community, but not as a measurement endpoint for risk characterization. The proposed level of analysis is appropriate for generally characterizing the aquatic community for receptor characterization purposes. The text has been revised to clarify the appropriateness of tissue testing in the May to June sampling period during Phase 1.

58. List of Acronyms, page xii - NJDOH is not in the acronym list.

Response: Change made.

59. Executive Summary, page ES-1 - Define the acronyms PRP (first sentence) and COPCs (last sentence).

Response: Change made.

60. Executive Summary, page ES-1 - 2nd paragraph, last sentence: Work (Plan) should start with a capital letter.

Response: Change made.

61. Executive Summary, page ES-2 - Define the acronym NCP (3rd paragraph).

Response: Change made.

62. Executive Summary, page ES-4 - COPCs is first mentioned on page ES-1. Please define on first instance.

Response: Change made.

63. Executive Summary, page ES-5 - Please define NJMC (last paragraph).

Response: Change made.

64. Executive Summary, page ES-6 - 1st paragraph, 2nd to last sentence: This sentence is should read, "…into a tidal estuary that transformed…" or "… into a tidal estuary that affected…" Please fix this sentence.

Response: Change made.

65. Executive Summary, page ES-6 - Define the acronym NJDOH (2nd paragraph).

Response: Change made.

66. Executive Summary, page ES-6 - (2nd paragraph) "Hasbrouck Height" should be "Hasbrouck Heights".

Response: Change made.

67. Executive Summary, page ES-9 - Figure 2-10 does not appear to be included in the report.

    Response: The reference is to Figure 2-3, not Figure 2-10. Change made.

68. Executive Summary, page ES-12 - The acronym in the sub-heading should be "CSMs."

    Response: Change made.

69. Executive Summary, page ES-13 - Fix first sentence: "A series of CSMs have been developed…"

    Response: No change necessary. The sentence, as written, is grammatically correct.

70. Executive Summary / 2.6, pages ES-14 / 2-15 - Suggest rewriting 7th bullet of ES and last sentence of Section 2.6 as follows: " Although deposition occurs throughout the BCSA, higher deposition rates are likely in the UBC, LBC, and the Phragmites marshes areas."

    Response: Change made.

71. Executive Summary, page ES-21 - The Executive Summary references figures from other sections of the report and includes embedded figures (e.g., Figure ES-1 is the same as Figure 1-1). Report should be consistent in references.

    Response: Because the Executive Summary draws figures from throughout the Work Plan, but must clearly and easily direct the reader to the relevant embedded figure, no change was made in response to this comment.

72. Executive Summary, page ES-26 - Define the acronym IRM.

    Response: Change made.

73. Executive Summary, page ES-27 - Reference "USEPA, 1990" should be 1990a.

    Response: Change made.

74. Executive Summary, page ES-27 - Reference "USEPA, 1997b" is for ecological risk assessment; perhaps it should read "USEPA, 1997d."

Response: Change made.

75. Section 1.2, page 1-2 - For any study questions in the Framework Document that were not incorporated into the Work Plan or were substantially revised, please provide an explanation.

    Response: As discussed in the January 22, 2009 work session, the BCSA Group project team developed conceptual site models (CSMs), based on the additional data generated and compiled during the scoping activities. These CSMs were part of the basis for the development of a set of study area questions that have been and will continue to be used to focus the RI and the FS. Additional, more specific study questions may be developed during subsequent phases of work.

76. Section 2.3.2, page 2-9 - I do not believe the Port Authority of NY&NJ was significantly involved in the NJ Transit expansion of the rail line to the Meadowlands Sports Complex. I believe that the New Jersey Sports and Exhibition Authority was the project sponsor.

    Response: The text has been revised.

77. Section 2.3.3.1, page 2-11, last line. Replace “sewer” with “sewage”.

    Response: Change made.

78. Section 2, Table 2-1 - Table 2-1 Indicates that there are 617 acres of wetlands in the BCSA. However, Table 2-2 indicates that there is an additional 110 acres of "Emergent Herbaceous Wetlands." Please clarify description of wetland types or modify tables accordingly.

    Response: Data sources used for tables 2-1 and 2-2 are different; citations for data sources have been added to these tables.

79. Section 2, Table 2-5 - Add a footnote with the definitions for "shallow" and "deep" for water depth.

    Response: Change made.

80. Section 2, Table 2-6 - Add a footnote with the definition for "cumulative count/2 years." Also, round numbers to the nearest ten.

    Response: Change made.

81. Section 2, Figures 2-2A and 2-2B - Make labels for the Hackensack River, Route 3, and I-95 more clear.

    Response: Change made. These figures have been re-formatted with an alternate label style.

82. Can tidal gates be located outside a body of water? Please check locations of gates near PIC and LBC

    Response: The tide gate positions as shown are based on a public-domain NJDEP dataset, which may be too regional in scale to accurately position tide gates that are sometimes placed in storm sewer lines beneath upland areas due to some tidal fluctuations in those pipes. We will confirm locations based on NJMC reports.

83. Section 2, Figure 2-2A - Clarify in the legend that the distance markers are in kilometers.

    Response: The header currently indicates that the distance markers are "Waterway Kilometer Markers".

84. Section 2, Figure 2-2B - It is not apparent that Eight Day Swamp is divided as East and West from this figure.

    Response: Eight Day Swamp is located on the east side of Berry's Creek Canal. The text and Figures have been made consistent.

85. Section 2, Figure 2-3 - Provide a legend. Also, it seems that there is an overlay on the rivers (thin blue lines) that doesn't match the lines from the background figure. Please correct this discrepancy.

    Response: A legend has been added and the river overlay clarified.

86. Section 2, Figure 2-6 - The green color for wetlands and forests is difficult to decipher. Suggest using a different color.

    Response: The forest and wetlands colors have been modified to make them easier to decipher.

87. Section 3.28, page 3-24 - MDWP was approved now.

Response: Change made.

88. Section 3 and throughout, general - Throughout the report, the nomenclature for valence states (e.g., Cr+2) needs to be consistent in report.

Response: Change made.

89. Section 3, Table 3-1 - Provide the relative distance to BCSA or sort stations from nearest to farthest.

Response: Text has been revised to show relative distance to the BCSA.

90. Section 3, Table 3-2 - Add a note on the "List of Acronyms" on page xi to refer to Table 3-2 for additional acronyms and abbreviations.

Response: Change made.

91. Section 3.2.2, page 3-4 - On Page 3-4, last bullet - Clarify how aerial surveys were able to identify "18 major storm events".

Response: A clarification has been made.

92. Section 3.2.5, page 3-9 - Clarify whether historical data will be available electronically in a database to USEPA.

Response: The form of compilation for past data and its use going forward has been evaluated in relation to Phase 1. A decision on its availability electronically will be determined at a later date.

93. Section 3.2.5.1, page 3-9 - Review of academic literature data should be included as a subtask. Discussion that data usability criteria for academic literature data (which included a peer review) will be different than a government/state sampling program (which is defined by an approved work plan).

Response: A separate subtask for academic literature data is not necessary as it is not clear how these data will be used in the RI/FS at this time.

94. Section 4.3.6, page 4-17 - Is there any information on the wastes at the Avon Landfill?

Response: There is limited information on the wastes at the Avon Landfill.

Additional review of landfill data will be conducted as part the Phase 1 work and reported in the Phase 1 report. No change necessary.

95. Section 4.3.6, page 4-17 - State that a portion of the NJSEA is built across from a former landfill area (similar to the description in the second paragraph on page 5-4).

Response: Change made.

96. Section 4.4.1.1, page 4-20 - The last sentence “close” should be “dose”.

Response: Change made.

97. Section 4.4.1.2, page 4-26 - The first sentence should read "human" not "ecological."

Response: Change made.

98. Section 5.1.1.1, page 5-4 - The first bullet should read, "The East Riser and West Riser Ditches…"

Response: Change made.

99. Section 5.1.1.1, page 5-4 - A primary source is the resuspension and redeposition of contaminated surface sediment in Berry's Creek and marshes. (The text describes sediment resuspension as a secondary/tertiary source in Section 5.1.2.2, page 5-6).

Response: Consistent with RI/FS guidance (EPA/540/G-89/004), primary sources are process, storage or conveyance structures of concentrated hazardous substances (e.g. tanks, drums, lagoons, effluent outfalls). Environmental media that contain relatively high concentrations of chemicals that originated from a primary source and can lead to the additional spreading of COPCs are secondary/tertiary sources (EPA/540/R-05/012). The importance of resuspension of sediments is presented in Section 5.1.2.2 (USEPA, 2005a).

100. Section 5.1.1.1, page 5-4 - What sampling or monitoring is anticipated on the landfills? What developments are planned on or near the landfills?

Response: See Specific Comment 4.

101. Sections 5.1.1.1, 5.1.2.2, pages 5-4, 5-6 - Clarify the terminology/definitions of groundwater and porewater. Groundwater is described as a primary source, but

porewater is described as a secondary source. How are these sources different?

Response: The text has been modified to address this comment.

102. Sections 5.1.1.1, 5.1.2.2, pages 5-4, 5-6 - Clarify the terminology/definition of atmospheric deposition. How can atmospheric deposition be considered a primary source as well as a secondary source?

 Response: The text has been modified to clarify that aerial deposition is a primary source and not a secondary source.

103. Section 5.1.1.2, page 5-5 - Air is considered to be a secondary or tertiary source, but is listed as a primary source on Figure 5-1.

 Response: See response to Specific Comment 102.

104. Section 5.1.2.2, page 5-6/Figure 5-1 - The transport mechanisms from pore water listed in the third paragraph are not depicted on Figure 5-1.

 Response: The figure has been modified appropriately.

105. Section 5.1.2.2, page 5-6/Figure 5-1 - Consider adding deposition to the fourth paragraph on air as shown on Figure 5-1.

 Response: The referenced paragraph has been deleted in response to comments SC 102 and 103.

106. Section 5.1.2.2, page 5-6/Figure 5-1 - For the primary source "air," consider adding "dispersion" to the release mechanism as stated in the text on page 5-6.

 Response: Change made.

107. Section 5.1.3, page 5-7 - Consider adding the word "aqueous" before "abiotic media" in the first paragraph.

 Response: Change made.

108. Section 5.1.4, page 5-7 - Avian species and benthic invertebrates are also receptors in the BCSA. Does "wildlife" include terrestrial and aquatic species?

Response: Yes, wildlife includes terrestrial and aquatic species. No change needed.

109. Section 5.1.3, page 5-7/Figure 5-1 - Consider adding a box around the exposure media sediment and pore water like that for surface water as indicated in the first paragraph.

Response: Change made.

110. Section 5.1.5, page 5-8 - What Habitat Zone defines the non-tidal tributaries of Berry's Creek (including East Riser and West Riser)?

Response: Current text describes that freshwater defines the non-tidal tributaries of Berry's Creek. No change needed.

111. Section 5.1.5, page 5-8 - The term "time" as a source is unclear. "Historical contaminant loading" or "Historical contaminant discharge" may be a more appropriate source term.

Response: Text was added to clarify meaning.

112. Section 5.1.5, page 5-8 - The footnote references in the second, third, and fourth bullets refer to footnote #3 instead of footnote #8. Check reference.

Response: Change made.

113. Section 5.2.1, page 5-10 - State how far (in river miles) dye traveled upriver in the Hackensack River, and note the distance to Berry's Creek. (Also state the farthest dye sampling station as well).

Response: Changes made.

114. Section.2.1, page 5-10 - "The authors reported very low freshwater flows from the rivers to Newark Bay (4.2 m^3/s and 0.29 m^3/s, respectively) during the period of the study." For clarity, the report should name the rivers in this sentence. It is assumed that the order of the values is Passaic River and Hackensack River as in the previous sentence.

Response: Changes made.

115. Section 5.2.2, page 5-11 - If the West Riser tidal gate is not operating correctly and is closest to the mercury contamination source at Ventron/Velsicol, then it is likely that contaminated solids have moved upstream into West Riser. Sampling for mercury should

extend into West Riser to determine how far such contamination may have moved.

Response: The Work Plan already contains a sampling program for upstream of the West Riser tide gate and the former Ventron Velsicol discharge point. Both BAZ sediments and sediments at depth will be sampled. No change was necessary.

116. Section 5.2.2, page 5-12 - First paragraph - There is only one Figure 5-8 instead of the two Figures 5-8 a,b, referenced. Please correct this inconsistency.

Response: Change made.

117. Section 5.2.3, page 5-14 - Has the tidal excursion distance been verified with a dye study? What data source measured 2.7 miles of excursion?

Response: The text has been clarified to describe how tidal excursion was estimated.

118. Section 5.2.3, page 5-14 - 3rd Paragraph: In the water budget, the marsh area characterization from the aerial photograph analysis (ELM, 2008a) goes back to 1951. That is approximately 60 years and not over the past 100 years that the tidal prism has been quantified. Also, it should be noted that there was an increase of Phragmites marsh area after the construction of the Oradell Marsh in the Hackensack River in 1922, which caused intrusion of brackish water to Berry's Creek. This means that due to the near elimination of freshwater flow from the Hackensack River it is likely that the tidal influences at Berry's Creek increased. Also, please add the full citation for "ELM, 2008" to the references section.

Response: Change made.

119. Section 5.2.4, page 5-15 - Section 5.2.4 needs to state how marshes can act as both a source and sink of contamination. Solids can be resuspended or transported into the marshes during high tide, and deposited and sequestered among the phragmites during low tide (i.e., the marsh is acting as a sink). However, high tide can also cause solids to be resuspended in the marshes and flushed back out to the creek (i.e., the marsh is acting as a source of contamination). Reference the discussion on page 5-21.

Response: The text (page 5-18) has been modified to address this comment.

120. Section 5.2.4, page 5-18 - In the second paragraph should it read "…flush through the system relatively rapidly?"

Response: Change made.

121. Section 5.2.6, page 5-20 - What data support the "net depositional" statement for the creek? What is the estimated net depositional rate?

Response: The text has been modified to clarify the basis for this statement and the estimated depositional rates cited.

122. Section 5.3.1, page 5-20 - Consider moving footnote 14 up to the first time that the term "interflow" appears.

Response: Change made.

123. Section 5.3.3.3, page 5-29, 4th paragraph - Mercury concentrations in fish tissue may be below mercury concentrations in sediment, but do they exceed standards? This section seems to be trying to downplay contamination concerns too strongly.

Response: A text modification has been made.

124. Section 5.3.3.3, page 5-30/Figure 5-14 - Discussion in the text hypothesizes limited mercury methylation or enhanced demethylation in the BCSA. However, methylation and subsequent biouptake has not been shown to be completely absent. Figure 5-14 should reflect the possibility of biouptake of methyl mercury as well.

Response: This information is already depicted in the figure.

125. Section 5.3.4, page 5-32 - Too much emphasis on lack of bioavailability in comparison to a multitude of potential biouptake pathways. This study has got to prove it in either case. Same comment for Section 5.4.2, page 5-41. Premature conclusion.

Response: The text has been clarified that these are not definitive conclusions.

126. Section 5.3.4, page 5-32 - Correct "BSASF" in the second paragraph to "BSAF."

Response: Change made.

127. Section 5.34, page 5-32 - If “traditional” BAFs or BSAF do not match what we are seeing in the BCSA, then we need to collect a more robust data set to develop site-specific biouptake models.

Response: No change needed to the Work Plan. The comment will be addressed in the BERA WP development.

128. Section 5.3.5, page 5-36 - In the last sentence of the last paragraph, correct "date" to "data."

Response: Change made.

129. Section 5.4.4, page 5-44/Figure 5-18 - Why is the osprey not included as a predatory bird for the freshwater portions? Also, note that the headings are "carnivorous birds" on Figure 5-20 and "wading birds" on Figure 5-18.

Response: The figures have been changed to use common terms across each and a sentence has been added that specifically explains why osprey were not depicted in the freshwater food web. In addition, see previous response to comment #37.

130. Section 5.4.6.1, page 5-47/Figure 5-21 - Representative species in the figure do not necessarily match the text. For instance, under waterway receptors, the great blue heron was selected as representative of wading birds, but the egret is listed in Figure 5-21. Expand the figure to better represent all the assessment endpoints.

Response: The figure has been revised.

131. Section 5.6, page 5-54 - In the first paragraph in Section 5.6, remove the extra word "to" in the second sentence.

Response: Change made.

132. Section 5.6.1, page 5-56 - The last sentence of the second paragraph seems to be missing something. Should it read, "..influenced by tidal flow in the Hackensack…?"

Response: Change made.

133. Section 5.6.2, page 5-58 - The second to last sentence of first paragraph should read, "…observations of human use will be compiled."

Response: Change made.

134. Section 5.6.4, page 5-60 - The last sentence in Study Question 6 should read, "…and

hydrologic interactions between…"

Response: Change made.

135. Section 5.6.5, page 5-61 - The first full paragraph should read, "…scientific literature has repeatedly shown…" or "…shown repeatedly…"

Response: Change made.

136. Section 5.6.6, page 5-62 - The first paragraph should read, "…the legacy and ongoing contamination may be…"

Response: Change made.

137. Section 5.6.6, page 5-64/Table 5-2 - Study Question 13 is not really an appropriate study question. If it can be rephrased to specify what information is needed, that would be fine, but a generic question of whether treatability studies are necessary is hardly helpful in focusing the RI/FS.

Response: The study question has been revised to make it less generic and more directed.

138. Section 5, Table 5-1 - For the freshwater waterways, remove blue crab as a representative species. (This species is not present in freshwater.)

Response: Change made.

139. Section 5, Table 5-1 - Red-tail hawk may have other measurement endpoints besides "sediment/surface water."

Response: See previous response to comment #37.

140. Section 5, Table 5-2 - Fix spelling error in Study Question #2 (e.g., "important").

Response: Change made.

141. Section 5, Table 5-2 - Remove the category headers on Table 5-2 or modify to correctly describe the study questions. For example, the header "sediment transport" has a study question for water and sediment transport. Recommend breaking up Study Question #4 into two pieces. For part 2, is the question referring to water, sediment, or both? The

study question on solid loads needs to be included. Also, the creek areas should be described as net depositional or net erosional.

Response: Based on the discussion in the January 22, 2009 work session, no change is necessary at this time.

142. Section 5, Table 5-2 - Add the study question on contaminant loading (current and historical), and relate it to solids load to create a mass balance.

Response: Based on the discussion in the January 22, 2009 work session, no change is necessary at this time.

143. Section 5, Table 5-2 - Study Question 8, The term "ranking" is unclear.

Response: A revision has been made to the text in Section 5.6.6 to clarify the use of ranking.

144. Section 5, Table 5-2 - What is the definition of "regional background contamination?"

Response: Regional background contamination has been clarified.

145. Section 5, Figure 5-1 - For the "ingestion/uptake" transport mechanism from surface water and sediment to biota, consider adding "contact" as an additional means of chemical bioaccumulation.

Response: Change made.

146. Section 5, Figure 5-2 - Figure 5-2 shows the connection of East Riser and West Riser to Berry's Creek; however, no sampling or monitoring is anticipated in these non-tidal waterways. Note that the tidal gate on West Riser is not functional; consequently, solids and surface water are exchanged.

Response: The sampling program in the Risers is designed to be limited and focused on defining gradients of COPCs near the tide gates. This approach was developed during site visits in June and the meeting held at EPA on July 2, 2008.

147. Section 5, Figure 5-2 - Suggest moving the "Segment Name" column all the way to the left.

Response: Change made.

148. Section 5, Figure 5-3 - Atmospheric deposition should also be shown in this figure. Also, deposition and resuspension are greatly affected by surface area.

Response: Change made.

149. Section 5, Figure 5-4 - Atmospheric deposition should also be shown in this figure.

Response: Change made.

150. Section 5, Figure 5-10 - A tide gate on Nevertouch Creek is shown in Figure 5-10, but is not shown in Figure 2-2; please correct this discrepancy. Also, in Figure 5-10, provide a box for Fisk Creek with the right interactions.

Response: Change made.

151. Section 5, Figure 5-14 - Consider adding the footnote on availability of burial reducing bioavailability from Figures 5-15 and 5-16.

Response: Change made.

152. Section 5, Figure 5-19 - Include blue crab among the benthic invertebrates.

Response: Change made.

153. Section 6, Table 6-1 - Clarify the exclusion of the NJDEP Sediment Quality Guidance Criteria (1998) from the ARARs list.

Response: See response to Specific Comment # 17.

154. Section 7.1 page 7-2, Surface water emphasis - Emphasis on the water column should not detract from studying a sediment derived food chain.

Response: Surface water is a primary point for biouptake, a major transport pathway and the primary media with chemical specific ARARs. Therefore, surface water was emphasized to some degree in parts of the evaluation, but not to the point that its relation to sediment is lost or the sediment-specific processes are not evaluated adequately to complete the risk assessment and alternatives analysis.

155. Section 7.2, page 7-4 - Why were the DQO steps re-worded? They should be used

verbatim.

Response: Notwithstanding minor editorial changes, the headings reflect the 2006 version of the QA/G-4 guidance document. It is possible that the reviewer compared the section headings to the 1994 version of the document, which has a somewhat different wording for the seven DQO steps.

156. Section 7.3.2, page 7-6 - Description of Phase 3 includes, "The third phase is expected to continue a routine monitoring component and include sampling necessary to fill any data gaps and needs to complete the risk assessments and detailed analysis of remedial alternatives, in addition to any treatability that may be necessary." The schedule in Section 11 and Section 13 infer that the feasibility study screening of alternatives will occur after Phase 2. The feasibility study is dependent on the completion of the risk assessment and completion of remedial investigation data gaps.

Response: The commenter is referred to the Statement of Work and guidance cited throughout the document to establish that the RI and FS should be conducted in a concurrent and iterative manner.

157. Section 7.3.3, pages 7-7, 7-8 - Phase 1 site characterization will likely be dependent on characterizing marshes and determining if marshes are acting as a source or sink of contamination to the creek.

Response: Please refer to the response to General Work Plan Comment 1, where the Group has agreed to add a marsh sampling program to the latter stages of Phase 1. Hence, no further change to the document is necessary.

158. Section 7.3.9, page 7-9 - The findings from all three phases of work, and thus the current understanding of the site, should be reflected in a Remedial Investigation Report.

Response: Agreed.

159. Section 8.1.1.2, page 8-6 - The Framework Document (Malcolm Pirnie, Inc., 2005) recommended the placement of a mooring location in the Hackensack River. Please explain this deviation from the Framework Document.

Response: As discussed in the January 22, 2009 work session, the BCSA is clearly defined in the AOC/SOW as the Berry's Creek watershed. The mooring stations in the Berry's Creek Canal and Lower Berry's Creek provide data reflective of the Hackensack River and the portions of the study area in close proximity to the

Hackensack River.

160. Section 8.1.1.2, page 8-8 - Correlation of turbidity to TSS needs to take into account potential impacts of primary production.

Response: TSS and turbidity measurements each encompass both the inorganic and organic fractions of particulates. Thus, development of a calibration curve between TSS and turbidity, as described in the work plan, will account for both inorganics and organics (i.e. sediment + phytoplankton + detritus). Further, the planned verification of the calibration on a monthly basis will evaluate if the TSS/turbidity correlation changes as a function of processes like primary productivity.

161. Section 8.1.2, page 8-15 - There is no discussion of water column stratification testing as was mentioned in the Framework Document. Please explain why such work was not deemed appropriate at this time.

Response: Based on the review of major studies of the lower Hackensack (BCUA, 1990) and the BCSA (Galluzzi,1982) referenced in the Work Plan, the system is well mixed and significant stratification has not been measured nor is it predicted to be a feature of the BCSA. In addition, because the BCSA is characterized by inlet channels (BCC, LBC) that are narrow and shallow relative to the Hackensack River, water entering the system is expected to rapidly become well mixed. As such, even if some stratification were present in the Hackensack it is not predicted to be a significant feature of the BCSA. Water quality monitoring to be completed under the Task 1 will further assess stratification, if any, in the BCSA.

162. Section 8.1.2.1, page 8-16 - Quarterly composite water column samples is not a lot of points to base transport analysis on.

Response: The currently-proposed monitoring is sufficient to provide a baseline understanding of site conditions. Based on these results, the value of more frequent monitoring will be considered in Phase 2.

163. Section 8.1.2.2, page 8-18 - Some description of the “clean hands-dirty hands method” for trace mercury analysis should be include in the text.

Response: The description of the clean-hands-dirty hands method is included in the Surface Water Sampling SOP in the QAPP.

164. Section 8.1.2.4, page 8-20 - A contingency plan should be presented for the manual storm event sampling program (if not all the locations are sampled during the selected storm event). What are the criteria for selecting a storm event?

Response: The criterion for selecting a storm is greater than 1 inch rainfall (97th percentile of daily total rainfall). Such storm events are of adequate duration as to provide sufficient time to complete the sampling program as described. No contingency is regarded as necessary.

165. Section 8.1.4, page 8-29 - The Work Plan describes a desktop study for groundwater in Phase 1. The Work Plan should state if a groundwater sampling program is anticipated for Phase 2.

Response: Section 8 describes the Phase 2 program and that groundwater sampling has been included.

166. Section 8.1.6.3, page 8-35 - What is the sampling density of crab and perch? These have not been described in the text.

Response: Text has been added to clarify the sampling density.

167. Section 8.1.6.3, page 8-37 - It would be good to analyze some number of individuals (not composited) for larger species to understand the range of contaminant levels within the population.

Response: Depending on the information gained from Phase 1 on the population/size structure of fish populations, the value of a size-specific sampling program will be considered as part of Phase 2 and during BERA WP development.

168. Section 8.1.8.4, page 8-46 - How many reference areas will be finally selected?

Response: The reference area assessment process is detailed in Appendix C, which has been referenced in the subject section.

169. Section 8.1.9.1, pages 8-47, 8-48 - Will the Data Management System contain all RI/FS data or just "tide elevations and other hydrodynamic data?" Will the database be publicly available? Will the USEPA have access to the DMS website and database?

Response: The DMS contains all field and laboratory analytical RI/FS data in

addition to hydrodynamic data. The particulars of access to the RI/FS data management system have been clarified in consultation with the USEPA.

170. Section 8.1.9.2, page 8-49 - Some portion of the data should be validated in each phase. This validation approach needs further discussion.

Response: Agreed. Representative percentages of the data will be validated in each phase. The data validation program has been clarified based on the site-specific methods development work and the work session discussion on January 21, 2009.

171. Section 8.2, page 8-57 - Some degree of low-resolution core sampling in the marshes should be conducted in Phase 1.

Response: As discussed in the January 22, 2009 work session, the Work Plan includes a provision to review the data from the waterways and evaluate what Phase 1 marsh sampling would be beneficial in planning the Phase 2 sampling program. Some coring in the marshes will be evaluated at that time.

172. Section 8, Table 8-2 - The last row is cut off.

Response: Change made.

173. Section 8, Table 8-2 - Task 1C "mobile hydrodynamic monitoring" will provide a snap-shot in time. How will these data be incorporated to show time-integrated data?

Response: The various types of data will be evaluated separately and in an integrated manner depending on the results and the patterns that become apparent during the analysis.

174. Section 8, Table 8-2, Task 1F - How long is the deployment to measure sediment flux and bedload from upland areas?

Response: As described on page 8-13, the sampling will occur concurrently with the quarterly monitoring and will include a storm event. The monitoring does not involve long-term deployment of sampling equipment.

175. Section 8, Table 8-2 - Task 1E and Task 1F should occur at same sampling locations (e.g., Berry's Creek Canal/Hackensack confluence, Upper Berry's Creek, and each Riser) to obtain grain size distribution and solids load.

Response: Tasks 1E and 1F cannot occur at the same locations as one is focused on the tidal area and the other is focused on the upland (non-tidal) area.

176. Section 8, Table 8-3, Surface water analytical parameters - How much water volume will be collected to quantify dissolved-phase hydrophobic contaminants (such as PCB and PAH) which will be mainly in the suspended-phase?

Response: The project QAPP contains information on sample volumes.

177. Section 8, Table 8-3, Surface water analytical parameters - Clarify whether suspended-phase or dissolved-phase pesticide will be analyzed. Recommend suspended-phase sampling.

Response: The Work Plan and QAPP have been clarified.

178. Section 8, Table 8-3 - Add PCDD/F to the analytical list.

Response: As discussed with EPA, PCDD/F will not be analyzed in Phase 1 for surface waters but will be analyzed in sediment in Phase 1.

179. Section 8, Table 8-3 - Automated samplers should include pesticides, PCDD/F, and total mercury.

Response: The rational for not including pesticides, PCDD/F and total mercury has been clarified in the text.

180. Section 8, Table 8-4 - Task 3C - The rationale for the coring program ("Geochronology for design of phase 2 deep coring program") is unclear. Deep cores cannot be predicted with surface sediment.

Response: The text has been revised to provide more rationale for the multi-phase approach to the coring program.

181. Section 8, Table 8-5 - Round areas to the nearest 10 acres. Round sample density to nearest 100. Explain more clearly the 10 additional head of tide samples and the 50 contingency samples.

Response: Areas and sample density have been rounded. Contingent samples have been removed from Phase 1. Phase 1 results will be evaluated fully and additional samples conducted in Phase 2.

182. Section 8, Table 8-6 - Task 6C - Add PAH to the analyte list.

The rationale for not including PAHs in the food web samples (relatively low potential for biomagnification in food web) has been added to the text.

183. Section 8, Table 8-8 - Page 2 of Table 8-8 is blank. Delete the blank page.

Response: Change made.

184. Section 8, Table 8-8 - If candidate reference sites vary in size, then more samples will be needed from the larger reference site to maintain a constant sampling density. Where will the 3 proposed sampling locations be in the reference areas?

Response: Section 8.1.8 of the Work Plan describes the sampling program for the reference areas. Clarification has been added to section 8.1.8.2 to describe that the survey of field parameters (Task 8B) will be used to determine the most appropriate sampling locations for each reference area. Samples of surface water, sediment and biota from the preferred locations in each reference area will provide several lines of evidence to compare (including a mean and standard deviation) the candidate reference areas with the corresponding portion of the BCSA.

185. Section 8, Table 8-8 - Task 8C - Surface water - Add PCDD/F to the analyte list, and analyze hydrophobic compounds on suspended solids.

Response: The rationale for not analyzing for PCDD/F and hydrophobic compounds on suspended solids in Phase 1 has been clarified in the text.

186. Section 8, Table 8-8 - Task 8C - Biota - Add PAH to the analyte list.

Response: PAHs have been added to the analyte list. The text and tables in Section 8, and appropriate portions of the QAPP have been modified.

187. Section 8, Table 8-9 - "Phase 3" column - Does the term "none" refer to no validation or no field effort anticipated? Add a footnote to clarify.

Response: Clarification has been made.

188. Section 8, Figure 8-4 - East Riser and West Riser on either side of the airport are not well samples.

Response: Clarification has been made.

189. Section 8, Figure 8-7 - Does this field sheet constitute an angler survey? How long will human exposure activity last?

Response: This is not an angler survey, although any observed angler activity will be recorded. Human activity is to be recorded on the log sheet by all field personnel while conducting any field work.

190. Section 9.1.1, page 9-3 - The hypotheses stated on page 9-3 infer that there is no ecological risk in Berry's Creek compared to the selected reference areas or the Meadowlands in general. For a hypothesis to be true, the SLERA must disprove the hypothesis by showing that there is an ecological impact in Berry's Creek.

Response: Agree. However, the Statement of Work and the Work Plan assume the SLERA will determine there is a risk. No change is necessary.

191. Section 9.1.1, page 9-3 - The general hypothesis identifies resident wildlife populations. However, the greater yellowlegs, selected as representative of shorebirds as a waterway receptor, are migratory and only winter in the area.

Response: Yellowlegs is present Spring thru Fall. No change made but the comment will be considered in the preparation of the BERA work plan. See response to comment #37.

192. Section 9.1.5, page 9-6, Step 7 - Risk Characterization: Consideration should be given to exposure to multiple COPCs that produce the same or similar toxic effect (e.g., reproductive).

Response: The occurrence of multiple COPCs will be evaluated as this is standard risk assessment procedure. No change is necessary.

193. Section 9.4, page 9-9 - Consider collapsing the first two bullets, as the second just indicates one criterion that will be used to select COPCs.

Response: Change made.

194. Section 9.4, page 9-10 - Refer to the site as BCSA as in the rest of the text.

Response: Change made.

195. Section 9.4, page 9-10 - Last sentence: A Draft and Final BERA report should be submitted so that USEPA can comment.

Response: Change made.

196. Section 10.1, page 10-1 - Reference "USEPA, 1997b" is for ecological risk assessment; perhaps it should read "USEPA, 1997d."

Response: Change made.

197. Section 10.1.2.1, page 10-2 - Human presence at the airport and meadowland center should be documented but classify it as restricted use?

Response: The assessment of risks in the study area is in the tidal area rather than in the surrounding upland area. The high density of human activity in the surrounding upland is noted and will be recognized throughout the risk assessment process. No change is necessary.

198. Section 11.1.1, page 11-2 - Numerical analysis to compare alternatives should not be used.

Response: As discussed with the EPA RPM, a comparative numerical analysis will be used as a tool to more objectively apply the expertise of the core group of team members conducting the alternative analysis and illustrate in a transparent manner the logic for the rating of alternatives. The process will be included as part of risk management work sessions (Phase 2 and 3) with EPA and other agency personnel where the trade-offs and ranking of alternatives will be evaluated. The text has been revised to include more detail about the use of comparative numerical alternative analysis.

199. Section 11.1.2, page 11-2, first bullet - The emphasis on the tidal prism from the Hackensack in the text strongly suggests that the study should extend into the Hackensack to some degree in Phase 1, so as to start to understand the boundary conditions at the site.

Response: As described on page 8-6, there will be moored hydrodynamic stations near the confluence of Berry's Creek Canal and Lower Berry's Creek with the Hackensack River as well as other points through the BCSA. These will provide

extensive data on the influence of the Hackensack River tides on the BCSA. In addition, tidal flux information is available for the Hackensack River in close proximity above and below the BCSA (Amtrak Swing Bridge, Carlstadt (2 locations)) from other sources. No change is necessary.

200. Section 11.1.2, page 11-3 - FS alternatives will consider several elements including "elevated nutrients and pathogens in the BCSA, which impacts wildlife." Please elaborate on the pathogens present in the BCSA in the document.

Response: Reference and summary discussion of pathogens can be found on pages 4-11 and 4-12 of the document.

201. Section 11.1.2, page 11-3 - "The combination of changes in hydrology and salinity, organics and nutrients loading, and urban runoff all favor a Phragmites marsh system in the BCSA." Will the FS consider restoration efforts to restore spartina growth?

Response: Before restoration alternatives can be scoped in any detail, the cause and effect relationships of COPCs to vegetation need to be evaluated. Nonetheless, *Spartina* will be included as a component of habitat enhancement options in some remedial alternatives. No change necessary.

202. Section 11.2.1, page 11-5 - bulleted list of technologies includes "institutional controls" twice, and then again in subsequent text. Please delete the two bullets, and just include the reference to it in the text.

Response: Change made.

203. Section 11.3.1.5, page 11-8 - Phase 2 FS tasks (screening of alternatives) should be dependent on the risk assessment, modeling results, and comments from USEPA on Phase 2 field results.

Response: Additional detail regarding the screening of alternatives has been added to the text, including consideration of the risk assessments to date, modeling results (if applicable), and USEPA comments on the Phase 2 field results.

204. Section 11.4, page 11-9 - Phase 3 field efforts are not defined. How can Phase 3 FS tasks be dependent on their results?

Response: As noted throughout the Work Plan and outlined in the SOW, the RI and FS are conducted concurrently. As a result of the screening of alternatives in

Phase 2, data needs will be identified to be collected in Phase 3. Detailed alternatives analysis will then be conducted as a part of Phase 3. Any FS data needs identified in Phase 2 will be collected during the Phase 3 work. This process has been clarified in the Work Plan.

205. Section 12, Table 12-1 - EPA project manager's name is Doug Tomchuk. Phone number is 212-637-3956, and email is tomchuk.doug@epa.gov. (I didn't check everyone else's contact information, but hope it was better than mine, or the whole table is pretty useless.) Steve MacGregor's phone number is 609-633-1347. Ed Demarest no longer works at NJDEP.

Response: Change made.

206. Section 12, Figure 12-1 - What companies compose the "BCSA Consultant Field Team?" What are the responsibilities of Jeff Shelkey (EEA, Field Sampling)?

Response: Change made.

207. Section 13, 11.3.1, 13-1, 11-6 - Each phase of field work is concluded with a sampling report and "FS and risk assessment efforts." Please provide more detail on FS related work that will occur in Phase I and Phase II. For example, how will it be different from Phase III FS efforts? Or, add a reference to Section 11. The Phase II FS tasks (screening of alternatives, page 11-6) should be dependent on the completion of the risk assessment and modeling.

Response: As noted in response to preceding comments, additional detail on the FS work that will be completed in each phase has been added to the text.

208. Section 13, 13-1 - Does weather-dependent storm event scheduling consider successful and unsuccessful attempts?

Response: Yes. No change is necessary.

209. Section 13, Figure 13-1 - The schedule highlights preparing material. However, submittal dates are not highlighted.

Response: As discussed with the RPM and Project Coordinator, some clarification of submittal dates has been added.

210. Section 14, 14-26 - USEPA references "USEPA, 1999a" and "USEPA, 1999b" are out of

order.

Response: Change made.

APPENDICES

Appendix A -Berry's Creek Water Budget

1. Appendix A - It was expected to see a box diagram (or boxes, if needed) with a generalized budget for the BCSA. That is a box showing the inputs, outputs, and internal movements of the system and that tried to quantify the estimated or measured flows. The model components would include at least: storm runoff from undeveloped areas, storm runoff from developed areas, ET estimates, precipitation measurements, estimates of recharge to ground water, ground-water input to tidal prism (base flow), recharge of tidal water to and from ground water (interflow), point-source inputs, tidal flow from the Hackensack River, tidal flow back to the Hackensack River, flow into and from the marsh areas

   Response: Appendix A includes a simplified box diagram (Figure A-15). More detailed box diagrams depicting the understanding of the hydryodynamics and sediment dynamics of the system are provided in the work plan (Figures 5-10 and 5-13).

2. Appendix A, Section 3.1.3 - The source of the stage elevation values used for calculations of the tidal prism was not fully clear. Were these measured, estimated, or modeled? Are they assumed to be the same level through the whole basin?

   Response: The text has been clarified.

3. Appendix A, Section 3.2 - It seems that the water budget as it is now is generally based on assumptions and published values. It was not clear which values would be measured directly during the upcoming investigations to improve the analysis for this basin.

   Response: Additional detail has been added to the data gaps section regarding the specific data to be collected.

4. Appendix A - The analysis for stormwater runoff relied on the program WinTR-55. I am not familiar with this model, so I am not sure how well this accounts for this urbanized basin.

   Response: The appropriateness of the program for urban areas has been clarified in the text.

5. Appendix A, Section 3.3.2 - The text cites the RI Report of Operable Unit 1 for the gradient estimate of 0.005. This is an average gradient for the headwaters area. Could measuring actual ground-water levels throughout the BCSA, and calculating maximum and minimum gradients, be more helpful to understanding flow and assessing the exchange of surface water and ground water.

   Response: More detail has been added to the text indicating that the ground water flux calculations will be refined as the RI progresses and specific areas of interest for groundwater flux are identified.

6. Appendix A, General - Why were 1960 and 1990 picked for the water budget?

   Response: The text has been modified to ensure that it is clear why these dates were selected.

7. Appendix A, General - There are many data gaps that need to be filled. (However, the author has recognized the weakness of the water budget in Section 5.)

   Response: The preliminary water budget included in the Work Plan was completed to assist in the planning of Phase 1, in particular the hydrodynamic studies. No change is necessary.

8. Appendix A, page ii - Make the list of tables and figures consistent with the names found on the actual tables and figures (Tables A-6 and A-7 and Figures A-1, A-4, A-5, A-6, A-7, and A-10).

   Response: Changes made.

9. Appendix A, page 1-1 - Define acronyms NJDH and BSAWA.

   Response: Changes made.

10. Appendix A, page 1-2 - The last line should read, "The hydraulic connection of…" or "The hydraulic connection between…" Please fix this sentence.

    Response: Change made.

11. Appendix A, page 3-1 - The location of station one should be shown on the figures.

Response: Change made.

12. Appendix A, page 3-2 - Interpolation of the areas should be fully described in the text and/or present in a figure.

    Response: The method of interpolation of areas described on page 3-2 was reviewed and found to be complete and accurate. The Group's project team requests clarification of the comment so that future deliverables can provide more relevant detail where warranted.

13. Appendix A, pages 3-2, 3-3 - Delete periods from subheadings.

    Response: Change made.

14. Appendix A, page 3-3 - Is it reasonable to assume that bathymetric contours have not changed significantly from 1960 to the present? The conclusions state that the system is net depositional. This means that subtidal volumes have been underestimated for 1960.

    Response: The implications of this assumption have been more clearly acknowledged in the text.

15. Appendix A, page 3-5 - It is understood that these are only preliminary calculations and that data gaps need to be filled. It should be considered that land use in 1960 may have differed from current conditions. Therefore, there should be a different set of runoff calculations for this time period.

    Response: Review of the aerial photographs suggests that, with the exception of the infilling of marsh land associated with the construction of the NJSEA, the BCSA was largely at its current level of development by 1960 and land use has not changed substantially. The text has been modified to clarify this point.

16. Appendix A, page 3-9 - As discussed in Section 5, base flow should be better quantified. Current freshwater flows were missing many data. The comparison to recorded data from 1982 is not robust.

    Response: Quantification of freshwater flows is a primary objective of the Phase 1 hydrodynamic investigation.

17. Appendix A, page 4-2 - Delete the additional period and spaces from the 3rd paragraph

before the last sentence.

Response: Change made.

18. Appendix A, page 4-4 - See comment on Work Plan Section 5.2.3, page 5-14.

Response: Change made.

19. Appendix A, Table A-1 - Make the description of segments consistent with Figure A-2.

Response: Change made.

20. Appendix A, Table A-4 - See comment on Appendix A, page 3-3 about subtidal volumes.

Response: See above response to comment # 14.

21. Appendix A, Tables A-6 through A-9 - Please make the tables consistent with each other: Woodbridge shows a different reference in Tables A-6 and A-7 and different significant figures. There is an additional reference for Triboro STP in Table A-7 that is not on Table A-6. The reference for Matheson Gas Corp. is different in Tables A-7 and A-8 and the same for N.J. Sports & Exposition Authority.

Response: Tables A-6 through A-10 have been revised. Further, the associated modifications to Attachment 1 as a result of these revisions have been made.

22. Appendix A, Table A-8 - What does the ""No. of Discharges"" column mean? For Wella Corp., is the Water Budget Segment ID supposed to be 2 for East Riser? Also, please make the name of the locations consistent with Figure A-2.

Response: A footnote has been added to define "No. of Discharges" and the table has been revised to address this comment.

23. Appendix A, Table A-9 - For West Riser in Tables A-7 and A-8, discharges are tabulated for segments 1 and 3. However, in Table A-9, flow rates are only shown for segment 1. Please make all tables consistent.

Response: Changes made.

24. Appendix A - How was the 1990 discharge for West Riser calculated? For Middle Berry's Creek (segment 14), according to the notes, the STP flow was diverted in 1988.

Therefore, the discharge for 1990 should not include this source.

Response: The referenced note refers to discharge from the "joint meeting" STP. The Wood-Ridge STP, which discharged to the West Riser, was active until 1991. The table notes have been modified to clarify this point.

25. Appendix A, Figure A-2 - Show the segment type in the legend. Also, make the names consistent throughout Appendix A.

    Response: Changes made.

26. Appendix A, Figure A-3 - The average tide is reported as 5.5 feet in Figure A-3 and 5.6 feet in the text. Please correct this inconsistency.

    Response: This inconsistency has been addressed and the notes clarified.

27. Appendix A, Figure A-4 - "Are the background photographs a mix from 1951 and 1971?

    Response: The background photo used in this figure is dated 1961, chosen to best represent the 1951 to 1971 range. The air photo citation has been added to the figure notes.

28. Appendix A - Is there any information about the tide gates in the 1960 period? It would be more appropriate to used tidal gate data from this time period since current functionality doesn't add anything to the figure.

    Response: Information regarding tide gate functionality during this time period is not readily available but the available information will be reviewed for references to this period.

29. Appendix A, Figure A-15 - Please make the segment names consistent. Also, show arrows going both ways where applicable.

    Response: Change made.

30. Appendix B, General - Documentation should be added for the April 4, 2008 site reconnaissance visit.

Response: Documentation already exists in Appendix B for the April 4 visit. See disk included in Appendix B.

31. Appendix C, General - Briefing document Candidate Reference Areas: The first paragraph of the Site Tour section seems to indicate that reference areas will be selected that have CERCLA sources similar to those that are the subject of the BCSA RI/FS. However, bullet number 3 beginning on page 3 indicates that the Site Tour participants agreed that reference areas should have minimal influence from CERCLA-type stressors. Reconcile if necessary.

    Response: Appendix C text has been clarified to address the comment.

32. Appendix C, page 4 - Please correct the spelling error: "Based on this diversity of stressor sources and gradient of natural conditions such as depth, inundation frequency and salinity, no one reference AREA can be selected for the BCSA.

    Response: Change has been made.

33. Appendix C, page 6 - "In addition, with loss of the primary upstream sediment source (upper Hackensack River) and increased upstream flow of the tide from Newark Bay, there is a net upstream movement of sediment into the lower Hackensack River, including the BCSA (BCUA, 1990; USFWS, 2005)." Clarify this statement; solids from Newark Bay are transported upriver into the Hackensack River and pushed by the tidal cycle into Berry's Creek, meaning that Berry's Creek is net depositional.

    Response: The text has been clarified.

34. Appendix C, page 7 - "… there are a large variety of virulent viruses, bacteria and protozoa in the surface water and sediment throughout the lower Hackensack River..." Will a pathogen study be conducted as part of the HHRA?

    Response: See response to Work Plan specific comment number 200. A pathogen study will not be conducted. Fecal coliform will be analyzed in surface waters.

35. Appendix D, General - Hard-copy of Work Plan includes a tab for Appendix D; however, no material is presented for this tab. Delete if not necessary.

    Response: No change needed.

QUALITY ASSURANCE PROJECT PLAN (QAPP)

General Comments

1. All comments made on the Draft RI/FS Work Plan also apply to the Draft QAPP and should be changed accordingly. For example, similar text to the RI/FS is included in the QAPP regarding depurating mummichogs and fiddler crabs (worksheet 17 and Appendix B).

   Response: The Group's project team has reviewed and cross-checked the changes that apply to both the Work Plan and the QAPP. Revisions have been made where appropriate.

2. There are numerous inconsistencies in the QAPP Worksheets throughout the document. Many of these are pointed out in the comments provided. Please confirm that the information presented in all the QAPP Worksheets is consistent.

   Response: The information presented in the QAPP Worksheets has been checked for consistency.

3. It would be helpful to the reader if the QAPP included an introduction giving a summary of the project background, objectives, and tasks.

   Response: Based on the January 22 meeting with EPA, no change is needed.

Specific comments

1. Radionuclides in sediments will be analyzed according to the QAPP (worksheets #12, 15, 19, 28, 30). It appears that the radionuclides proposed for analysis are those that will be used for geochronological purposes. Those radionuclides used for dating are not to be included in RAGS D Table 6.4.

   Response: Agreed. No change.

2. Please provide a reference for the Oak Ridge National Laboratory Screening Levels (Human Health Based Project Action Limits) in Table 1c of worksheet #15. EPA could not locate the source of these screening levels. It is recommended to use "Regional Screening Levels for Chemical Contaminants at Superfund Sites" tables, which can be found at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm,

for human health. The cancer risk should be set at 1 x 10^{-6} and the non-cancer hazard should be set at a hazard index of 0.1.

Response: A reference has been provided. Calculator from suggested reference at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm was used with the default settings for the fish scenario.

3. Appendix C, SOP 1.2 - For suspended sediment sampling under low flow conditions, the sample will be collected by immersing a 1-L open-mouth plastic bottle from the surface, lowering it to the streambed, and returning it to the surface. Please indicate if a sampling apparatus will be used to hold the bottle or what steps will be taken to ensure that the sample is not contaminated upon collection .

   Response: The text has been modified to address this comment.

4. Appendix C, SOP 1.2 - For high flow suspended sediment and bed sediment transport sampling, please make note of the tide cycle (e.g. incoming or outgoing, high or low, spring or neap) in which samples are to be collected.

   Response: Section 2.3.2 of the SOP has been updated.

5. Appendix C, SOP 3.2 - For sediment sampling using the box corer and Ted Young grab sampler, the SOP stipulates that water above the sediment should be siphoned off, ensuring that fine-grained suspended sediment is not siphoned off. This seems to be an impossible task. Perhaps simply revise to say that the sampler should ensure that the sediment surface is not contacted during siphoning.

   Response: The SOP has been modified.

6. Appendix C, SOP 3.2 - For sediment sampling, please provide a description on when the split spoon method would be appropriate and at what sample depth.

   Response: Based on the methods development evaluation, the split spoon method has been eliminated.

7. Worksheet #2, QAPP/FSP Identifying Information, page 10 of 838 - The list of data users should also include the project's stakeholders.

   Response: Change made.

8. Worksheet #12, Measurement Performance Criteria Table - The introductory narrative to the worksheets indicated that these worksheets contain laboratory specific measurement criteria. The information for these worksheets should also include any project specific measurement criteria. This could include any QC samples and related criteria that will be used to assess the field sampling errors. The worksheets contain a QC sample labeled as duplicate sample (DUP). Please clarify if this indicates a field duplicate sample. Typically, a field duplicate sample will assess errors not only related to the analytical process but also used to assess sampling errors. In addition, there are instances where duplicate samples would mean laboratory duplicate. In this case, this sample would be used to assess analytical errors. Specifically, laboratory duplicates are specified with the CLP SOW for inorganic analysis. Therefore, the types of duplicates that will be used should be clearly specified in these worksheets. Also, some worksheets left out the information related to error assessments with the matrix spike/matrix spike duplicate samples and the worksheet related to SW-846 6020 (pages 108-110) is missing the error assessment information.

   Measurement performance criteria associated with other data collection activities should also be documented. These would include the data being collected for use with the hydrodynamics, hydrology, sediment transport studies and biota survey.

   Response: Project specific method performance criteria have been added to the table for field QC samples. Clarification has been added to the table to distinguish field and laboratory duplicates. The table has been reviewed and updated for method specific performance criteria for the MS/MSD samples. Measurement performance criteria have also been included for field parameters related to field water quality analysis. Because the measurement performance criteria for data being collected for use with the hydrodynamics, hydrology, sediment transport studies and biota survey are based on a broader data set and cannot be measured through the use of just one analytical technique they are not applicable to inclusion in WS#12..

9. Worksheets #15, Reference Limits and Evaluation Table - It was stated in the introduction to the table that trace level methods will be compared against medium/high range methods. The rationale for this type of comparison between methods that are capable of different detection limits is not clear. Instead of using the comparison to determine the most appropriate quantitative/calibration range for the COPCs and matrices, it is recommended that the project action limits provided in these worksheets be used to select the method(s) based on the laboratory's achievable limits to meet the project action limits. Since there are also two sets of project action limits listed for each of the matrices to be sampled, there is a potential for reducing the number of samples to

be analyzed if clearly the achievable laboratory limits for the method do not satisfy the action limits to be used. This can be used as an initial evaluation of each method's performance to meet the project's action limit relative to the matrices and/or concentrations from the site. In addition, the information related to the radionuclides analysis of the sediment should be completed for these worksheets.

Response: The worksheet has been updated.

10. Worksheet #28, Laboratory QC Samples Table - The reference Attachment 1 on page 659 of 838 for the SW-8260B LCS control limits and the MS control limits from STL Knoxville could not be located with the supplied project documentation.

    Response: This has been corrected. A revised SOP from TA Knoxville is included in Appendix D of the QAPP.

11. Worksheet #33 QA Management Reports, page 817 of 838 - The delivery date for the field safety audit report is incomplete.

    Response: An approximate time frame has been supplied in the table.

12. Worksheet #34 Step 1 Verification (Completeness Review), page 822 of 838 – Since UFP-QAPP Manual Figure 38 was being used as the reference information for the QC Summary Report verification, will the same description provided in UFP-QAPP Manual Figure 38 also be used to describe this verification input for the project? It is recommended that the description be provided instead of just giving a reference to UFP-QAPP Figure 38 to avoid any misunderstanding. In addition, the personnel responsible for verifying this information should be provided.

    Please verify the information presented for item nos. 26, 27, and 46. They were duplicates of the preceding information. Additionally, this table only presented the data review process that will be used for laboratory generated data. There are also data that are not laboratory generated but are generated for use with the hydrodynamic, hydrological and biota studies. The data review process that will be used for these data sets also should be provided.

    Response: Agreed. Clarification has been provided as well as the applicable field test information.

13. Worksheet #36 Steps IIa and IIb Validation Summary - A proposal was presented to reduce the data validation to a Tier II validation after completion of a full validation (Tier III) for all the samples collected under the methods development work and on a complete sample delivery group for each method and matrix at the beginning of the Remedial Investigation Task. However, it was not clear what Tier II validation would include. Please explain what the differences are between Tier III and Tier II validation. In addition, the complex matrices involved could present some challenges during the analysis. A rationale should be provided with any proposal for reduction in validation and should identify any critical measurement criteria that will be used. A reduction in data validation should be demonstrated by a history of high level quality work by the laboratories and contractors during the investigation. Additional information should also be provided to address any data quality issues identified during the reduced phase of the data validation.

    Response: Consistent with the discussions at the January 21, 2009 meeting and the findings of the site-specific methods development work, clarifications have been added to the worksheet.

14. Worksheet #37 Usability Assessment - It was indicated in the last sentence of the second paragraph on the first page of the worksheet that sample results that are rejected during data validation are not used in the decision-making process and should not be reported. Please clarify if this means that the result will be provided in the data report but with a rejection qualification and not totally left out. In addition, the paragraph that follows referenced an Attachment 1 along with Worksheet #11 for the project's DQOs. Please verify if the referenced Attachment 1 should instead be Appendix E which contains the data quality objectives process tables.

    In addition, what is the data usability assessment process for data that will be generated for use with hydrodynamic, hydrologic and biota studies? This should include any computer algorithms and statistics that will be used as part of the usability assessment.

    Response: Clarification has been added.

15. List of Acronyms, page 3-7 - Some of the terms (such as AU, BB, NC and RER) are not defined in the acronym list.

    Response: Change made. Acronyms have been double checked and verified for completeness and accuracy.

16. List of Acronyms, page 3-7 - To aid the reader, the first time an acronym is used in the QAPP it should be fully defined (even if it was defined in the Work Plan.)

    Response: Change Made. Agreed. This has been corrected throughout for each first use of an acronym.

17. Worksheet #2, page 13 - Please explain why item 5.3 is marked "NA". Worksheet #36 (page 829) appears to describe some possible streamlining of data validation.

    Response: Explanation has been provided.

18. Worksheet #4, page 15 - The worksheet indicated that the laboratory managers named will review Sections 3.2-3.5. Explain why the laboratory managers are not being asked to sign-off that they have reviewed all the applicable QAPP Worksheets with the information related to the analytical methods such as Worksheets #12, #15, #19, #23, #24, #25, #26, #27, #28, and #30.

    Response: Sign off cannot be completed until the final QAPP has been released. Sign off of all applicable individuals will be obtained upon the final issuance of the QAPP prior to the start of Phase 1 analytical work. We have added these pertinent sections to Worksheet #4.

19. Worksheet #4 and Worksheet #8, pages 15, 29 - Worksheet #4 lists selected laboratories (e.g., Test America, CAS, and Brooks Rand). However, Worksheet #6 states that the laboratories are to be determined (TBD). Worksheets need to be consistent.

    Response: Text has been updated based on methods development findings.

20. Worksheet #5, page 17 - The organization chart should show lines of communication between the project management staff, the project staff, and the field sampling team, and between the sampling team and the subcontract laboratories. We also suggest that the organization chart use a dotted line or separation between the Quality Assurance Manager and the Project Manager to indicate that she is independent from the project team.

    Response: Change made.

21. Worksheet #6, page 25 - Fit Susan Hill's name on the "Real time changes to sample collection or analysis procedures" line.

    Response: Change made.

22. Worksheet #7, pages 27, 28 - This worksheet should also list the field of study or experience in addition to the degree.

    Response: Given the multiple degrees held by the Team and the optional nature of this column, we prefer to limit our response to the level of degree and not provide additional details.

23. Worksheet #9, page 30 - Documentation should be added for the April 4, 2008 site reconnaissance visit.

    Response: Site reconnaissance visits are summarized in Appendix B of the project Work Plan.

24. Worksheet #10, page 38 - Problem Definition – Rather than just referring to the Work Plan, please identify the chemicals of potential concern that potentially affect the human and ecological receptors. The second paragraph mentions a method development component. Please explain why method development is necessary for this project, and clearly outline the goals of these method development activities.

    Response: Change made.

25. Worksheet #10, pages 38,39 - Add a footnote explaining why tasks #4,#5,and #7 are not listed on the worksheet.

    Response: Agreed.

26. Worksheet #11, page 40 - Same comments as Table 5-2 in Work Plan.

    Response: Clarification/consistency has been provided.

27. Worksheet #12, page 41 - This worksheet includes a table of contents for Worksheet #12. It would also be helpful to the reader if the analytical methods were added to this table.

Response: Agreed. Change has been made.

28. Worksheet #12, page 41 - Please explain why some of the labs will follow CLP statements of work, while others will be following non-CLP method criteria. We assume that this may be associated with the perceived need for "Method Development," but some explanation needs to be included in the QAPP. Also, an explanation is needed as to how these CLP and non-CLP data will be considered. For consistency of the data, it would be better to ultimately employ the same measurement performance criteria for the same matrix/analytical group.

    Response: Based on the results of the site-specific methods development work and the discussion with the EPA on January 21, 2009, only non-CLP protocols will be used. All CLP discussion have been removed from text.

29. Worksheet #12, page 41-43 - Please explain why there are so many different laboratories listed apparently to analyze the same parameters. We assume that this may be associated with the perceived need for "Method Development." For consistency of the field data, it would be better to ultimately employ a single laboratory for a given method/matrix/analytical group.

    Response: Agreed. The different laboratories were due to the MDWP work. For Phase 1 of the study, TestAmerica (TA) laboratories located in Pittsburgh (organics and general chemistry), North Canton (metals), and Burlington (particle size and cation exchange) will be used as the primary labs, each assigned specific methods and matrices, except the microbiological analyses (total and fecal coliform). Microbac laboratory will perform the microbiological testing. Brooks Rand and TA Knoxville are listed as contingency labs in the unlikely event that TA Pittsburgh, TA Burlington, or TA North Canton fails to perform to expectations or does not have adequate capacity to analyze samples in a timely fashion. The QAPP has been revised to reflect these laboratory selections.

30. Worksheet #12, pages 41, 42 - If samples will be distributed among different Test America Laboratory and Columbia Analytical offices, then a quality assurance program needs to be developed with split-sample analysis to verify similar test results among the various laboratory locations.

    Response: Please refer to response to comment 29 above.

31. Worksheet #12, page 42 - For Brooks Rand Labs, mercury and methyl mercury do not appear to be listed for tissue, but they are listed on Worksheets #15 and #28.

    Response: This discrepancy has been resolved on the worksheet.

32. Worksheet #12, pages 44-185 - Performance Evaluation (PE) standards for the critical chemical parameters PE standards should be added to the required Measurement Performance Criteria. The laboratories should be required to analyze the blind PE standard and meet the acceptance limits prior to analyzing any project samples and as a QC performed periodically throughout the study. Are PE standards being included in the "Method Development Activities?"

    Response: Blind PE standards were not included in the Method Development Activities but will be submitted to the laboratory(s) for analysis prior to the start of Phase 1. A row indicating PE sample analysis and measurement performance criteria has been added in WS#12 under each analysis where a PE sample is applicable. Blind PE samples will be submitted to the laboratory(s) prior to each phase of the study.

33. Worksheet #12, pages 44-185 - Please confirm that the Measurement Performance Criteria are consistent with the QC criteria (worksheets) which the laboratories will follow in their SOPs.

    Response: Yes. Measurement performance criteria (MPC) are consistent with the worksheets.

34. Worksheet #12, pages 44-185 - Please confirm the Measurement Performance Criteria for a given analytical group in a given matrix are consistent for all the laboratories. For example, all the labs analyzing for VOCs and SVOCs for the project should be required to meet the same QC and acceptance criteria.

    Response: MPC for metals will be consistent between the primary and contingency labs using 80 to 120% for Laboratory control samples and 75 to 125% for matrix spike samples (laboratories that use tighter limits are acceptable). The MPC limits for the VOCs and SVOCs may vary somewhat between the primary and contingency laboratory but are based on historical limits as specified by SW 846 method guidance for generating control limits for performance criteria. When generated in this manner the MPC reflects an accurate assessment of the laboratory's capability for each method and each compound within the method. In order to assign standard MPC for all laboratories to follow, a comparative analysis

would have to be performed between the laboratories on a compound by compound basis. The magnitude of this effort weighed against the chance of using a contingency laboratory does not warrant standardized MPC at this time.

35. Worksheet #12, pages 44-185 - Equipment blanks do not appear to be specified. We recommend that equipment blanks be collected with every batch of decontaminated equipment sampled for the key chemical parameters.

    Response: Equipment blanks have now been specified in Worksheet 12 as suggested by the reviewer.

36. Worksheet #12, pages 44-185 - Duplicates are listed, but it is not clear if these are field duplicates or lab duplicates. Field duplicates are recommended to measure sampling precision as well as analytical precision.

    Response: The duplicates in Worksheet 12 have been more clearly defined as either "field" or "laboratory" duplicates.

37. Worksheet #12, pages 174-175 - The analytical group should be "Mercury" instead of "Metals."

    Response: All of the analytical groups have been reviewed and appropriately named. Mercury has been used as the analytical group as applicable.

38. Worksheets #12, #15, and #28, pages 41, 198, and 630 - The tables of contents for Worksheets #12,#15 and #28 should be arranged in the same order for the reader and reviewer. Please confirm that the terminology used in the worksheets is consistent.

    Response: The order of these tables is now consistent. The worksheets have also been reviewed and revised accordingly for consistency in terminology.

39. Worksheets #12, #15, and #28, pages 41-185, 198-515, and 630-792 - The terminology used to describe some of the analytical groups in these worksheets appear to be inconsistent. The tables should be checked for consistency. For example:
    (A) For Test America (Pittsburgh, PA; Worksheet #12, page 42), Wet Chemistry is listed for Surface Water, Solid/Sediment, but in Worksheet #28 (page 631), a more detailed list of Wet Chemistry analytical parameters is listed. Also, in Worksheet #15 (pages 200-201), the term "General Chemistry" was used instead of the term "Wet Chemistry."

(B) For Columbia Analytical Services, Inc , (Worksheet #12, page 42), the parameter ""AVS-SEM metals"" was NOT in the table, but this parameter was listed in Worksheets #15 and #28. Also confirm that the descriptions for the wet chemistry parameters are consistent.

Response: Agreed. These worksheets have been reviewed and corrected as necessary.

40. Worksheets #12, #15, and #28, pages 43, 202, and 630-792 - BCSA Cooperating Parties Group was listed in Worksheet #12 (page 43) and Worksheet #15 (page 202), but was not listed in Worksheet #28.

Response: Worksheet #28 has been corrected.

41. Worksheets #12, #15, and #28, pages 184, 347, 785-786 - In the tables, the laboratory for "total coliform" and "fecal coliform" was listed as “To be Determined,” yet the parameters appear to have been assigned to New Jersey Analytical Laboratories. Please insure that the information is accurate and consistent.

Response: These tables have been updated to reflect Microbac Laboratories for total and fecal coliform.

42. Worksheets #12 and #28, page 183 - There is no Worksheet #28 QC table for the field parameters for the BCSA Cooperating Parties Group, but there a Worksheet #12 for the field parameters (see page 183).

Response: Worksheet #12 has been reviewed and revised as necessary.

43. Worksheet #13, page 188, Near Surface Sediment Core Data - The conclusion of limited recovery is not clear, especially if the objective was to measure the thickness of industrial-age sediment. Does "limited recovery" mean that the thickness was not measurable or that the thickness is zero?

Response: The text has been clarified.

44. Worksheet #13, page 188, Depth-Migrated, Sub-Bottom Seismic Profiles - The conclusion of "none identified" is not clear, especially if the objective was to measure the thickness of Holocene sediment.

Response: The text has been clarified.

45. Worksheet #13, page 188, Extent of Tidal Wetland - It is unclear if a more recent aerial survey was reviewed or just the 1986 aerial survey.

Response: The worksheet has been clarified.

46. Worksheet #13, page 189, Soil Characteristics - The objective of the soil data ("Estimate precipitation runoff and infiltration rates for uplands inputs into water budget") and the corresponding conclusion ("none identified") is not clear. Is the row header correct? Soils are present in the study area, so a conclusion of "none identified" is incorrect.

Response: The worksheet has been clarified.

47. Worksheet #14, page 190 - The proposed sampling tasks do not appear to mention chemical analyses. The sample matrixes and the analytical groups for chemical analyses should be described in the text.

Response: The QAPP cross-references the Work Plan as agreed upon in January 21, 2009 meeting with EPA.

48. Worksheet #14, page 190 - The location of the 4 long-term ADCP devices is unclear. Refer to the sampling map or describe the locations in the text.

Response: The QAPP cross-references the Work Plan as agreed upon in January 21, 2009 meeting with EPA.

49. Worksheet #14, pages 190-191 - Only "Sampling Tasks," "Analysis and Management of Data," and "Documentation and Records" are briefly described. All of the following project tasks should be described in Worksheet #14: Analytical Tasks, Quality Control Tasks, Secondary Data, Other Data, Data Management Tasks, Documentation and Records, Assessment/Audit Tasks, and Data Review Tasks.

Response: The QAPP cross-references the Work Plan as agreed upon in January 21, 2009 meeting with EPA.

50. Worksheet #14, page 196 - "Four candidate reference sites have been identified for the BCSA." Have these reference sites been approved by the USEPA? What is the approval process?

Response: The process to identify the four candidate reference sites is detailed in Appendix C of the Work Plan. The USEPA, NOAA and NJDEP participated in the process of identifying the candidate reference sites.

51. Worksheet #15, page 26 - Why are medium/high achievable lab QLs for sediment specified for semi-volatiles by CLP SOM01.2? They do not meet all the project action levels in the tables. Low level QLs are more appropriate.

Response: CLP is no longer being utilized on the project.

52. Worksheet #15, page 198 - It would be helpful to the reader if the test method references were also included in this table.

Response: Worksheet #15 has been revised for clarity.

53. Worksheet #15, page 198 - "The second paragraph mentions that "Multiple methods will be evaluated per the Methods Development Work Plan to develop comparative analytical performance data for each method with regard to each sample matrix and its physical and chemical influence on the project parameters of interest." We have several comments on this statement:
(A) The "Methods Development Work Plan" should be included as an attachment to the QAPP and should be available to be reviewed along with the QAPP.
(B) The decision criteria/standards that are proposed to be employed in the selection of the analytical methods which will be ultimately used to analyze the field samples collected for this project should be clearly stated and available for review as part of the QAPP.
(C) Rather than including information on multiple methods for the same parameter, the Final QAPP must clearly indicate the methods selected which will be employed for the project analyses task and the reasons why the selected methods are appropriate.
(D) The sample preparation and clean-up methods employed are also critical to the analyses of complex matrixes such as sediments. These methods should be specified in the Final QAPP.

Response: (A) The MDWP has been added as Appendix G. (B) The worksheet has been revised. (C) The worksheet has been revised. (D) The sample preparation and clean-up methods are included in the SOPs for Analytical Laboratories (Appendix D).

54. Worksheet #15, pages 198-493 - General comment: In many of the Worksheet #15 tables, the achievable lab QLs listed are higher than the project action levels, and therefore the data may not fully support the project objectives. Ideally, more sensitive sampling and analysis procedures should be specified to meet the proposed action levels in the QAPP/FSP tables and SOPs. If more sensitive sampling and analysis procedures capable of supporting the project action levels cannot be employed, the rational/reasons should be documented. For some analytical parameters, larger size samples can be collected in the field and analyzed by the lab to help achieve lower detection limits to support the project action levels. For example, for the determination of organic contaminates in aqueous samples, large volume sampling techniques can be employed to achieve lower detections limits for parameters such as PCBs, dioxins, and pesticides. In other cases, more sensitive analytical methods can be chosen or extracts can be further concentrated to achieve lower QLs.

    Response: No action based on discussions from the meeting of January 21, 2009.

55. Worksheet #15, page 199 - For the Test America (Burlington, VT) laboratory, there were only two concentration levels (medium and high) given for the metal parameters for sediments, but in Worksheet #12 (page 41) and Worksheet #28 (page 630), there were three concentration levels (low, medium and high) required for the metal parameters. Confirm that the QAPP Worksheets #12, #15 and #28 are all consistent.

    Response: No action based on discussions from the meeting of January 21, 2009.

56. Worksheet #15, page 200 - For the Test America (Knoxville, TN) laboratory, there were two concentration levels (medium and high) required for pesticides parameters in tissue samples, but on Worksheets #12 and #28, there were three concentration levels. Please be sure that Worksheets #12 and #28 are consistent.

    Response: Worksheet has been updated.

57. Worksheet #15, page 202 - Why are medium/high achievable lab QLs presented for sediment volatiles by SOM01.2? The medium/high QLs do not meet all the project action levels.

    Response: The worksheet has been clarified.

58. Worksheet #15, page 213 - Regarding method SOM01.2 (PCB, water), the determination of total PCBs as Aroclors (by SOM01.2 and or SW-846-802) does not meet the project action levels given for total PCBs in water. Total PCBs should be analyzed for by EPA method 1668A as individual congeners. It may also be necessary to employ large volume water column sampling techniques.

    Response: No change required at this time, pursuant to discussions at the meeting on January 21, 2009.

59. Worksheet #15, page 323 - Reference limits for radionuclides – The achievable lab limits and proposed project QLs are not sufficiently low enough to allow for dating of the sediment. In our experience, to adequately date the sediment, the lab's achievable QL for Be-7 should be at least as low as 0.3 pCi/g, and the lab's achievable QL for Cs-137 should be at least as low as 0.05 pCi/g. The lab should be capable of achieving these lower detection limits by using a larger sample configuration and increasing the gamma spec counting time.

    Response: Due to the minimal amount of sample volume available for radioisotopic analysis, the lowest achievable reporting limit is 0.06, which will still allow for dating of the sediment. Should a larger amount of sample be provided to the laboratory for analysis, the reporting limit will be lower commensurate to the sample size.

60. Worksheet #15, page 327 - Regarding method SW846 8290 (dioxins in tissue), the achievable lab QLs do not support the project action levels. Also, EPA method 1613B is a better analytical method for dioxins since it uses more surrogate compounds and is recommended instead of method 8290 for the sediment, tissue, and aqueous samples.

    Response: Agreed. EPA method 1613B has been adopted.

61. Worksheet #15, page 349 - There is a table for "Sediment Oxygen Demand" on page 348, but this parameter is not listed in the table of contents for Worksheet #15 (pages 199 to 202).

    Response: SOD has been removed from the Phase 1 program.

62. Worksheet #15, pages 494-515 - Tables 1a through 2b summarize various criteria used to generate the project action levels. (Malcolm Pirnie did not verify the applicability of the criteria presented in these tables.) A footnote should be added indicating that USEPA's

approval of the QAPP does not mean that USEPA accepts the proposed action levels for this study as the remediation action levels for site.

Response: Agreed. Footnote has been added.

63. Worksheet #16, page 516 - A summary (at the very least) of the project schedule should be included in the QAPP so the reader will understand the timing and sequence of the key project tasks.

Response: Agreed, an approximate schedule has been included in the final QAPP.

64. Worksheet #17, page 534, MDWP Task 7 Analytical Methods Development - Large volume sampling methods should also be considered and investigated to allow the analytical method to achieve the project action levels. Also, the use of high resolution gas chromatography methods should be considered for the organic parameters such as PCBs, dioxins, and pesticides instead of limiting the consideration to SW-846 methods and CLP Statements of Work.

Response: Per the discussions during the January 21, 2009 meeting, no change is necessary.

65. Worksheet #17, page 534 - A task should be added describing data management and evaluation.

Response: This task has been added to the worksheet.

66. Worksheet #18, page 536 - Add text explaining/describing the "Location ID" and "Sample Numbers" and "Depth" columns. Are these column representing generic labels or do they represent specific locations and samples? (If so, include a figure of locations.)

Response: Clarification has been supplied in the QAPP worksheet #18.

67. Worksheet #19, pages 541-547 - SW-846-8081A and SOM01.2 are listed as methods for pesticides in sediment, water, and tissue samples. Both of these methods are based upon the use of Gas Chromatography-Electron Capture Detector (GC-ECD) instrumentation which responds to numerous interferences which may be detected in the sample, particularly in sediment samples. SW-846-8081A also does not appear to be sensitive enough to meet the project action levels for pesticides. For example, see the achievable QLs listed in Worksheet #15 (page 425) for water samples. Consideration should be

given to employing a high resolution gas chromatography mass spectrometry (HRGC-HRMS) method such as NYSDEC HRMS-2 to analyze for pesticides. In addition, larger volume samples can be collected to achieve the lower detection limits required to meet the project action levels.

Response: Based on discussions during the January 21, 2009 meeting, no change is necessary.

68. Worksheet #19, pages 541-547 - SW-846-8082 and SOM01.2 are listed as methods for PCBs as Aroclors in sediment, water, and tissue samples. We also recommend that the total PCBs be measured as PCB congeners by EPA method 1668A or CLP CBC01.0, which employ HRGC-HRMS. The PCB Aroclor methods are less sensitive and can underestimate or overestimate the total PCBs in sediment. These methods are also more prone to matrix interferences.

    Response: Based on discussions during the January 21, 2009 meeting, no change is necessary.

69. Worksheet #20, page 49 - A trip blank is not necessary for sediment/soil samples. Trip blanks are only used for aqueous samples.

    Response: Agreed.

70. Worksheet #20, page 549 - Inclusion and exclusion of the equipment blank is unclear. Add rationale to footnotes. (Equipment blanks will be needed for tissue samples, if samples are processed in the field.)

    Response: Rationale has been included in WS#20 notes 2 and 3.

71. Worksheet #23, page 581-586 - In a number of cases, older versions of the methods are specified. For example, ILM05.3 is specified on page 581. This is an older CLP Statement of Work. Please update the reference. The newer CLP SOWs allow for the option to employ more sensitive ICP-MS techniques for metals on solid samples. In the QAPP, the metals which will be determined by ICP-AES vs. ICP-MS should be specified for each matrix.

    Response: Non-CLP methods have been selected based on the results of the Method Development work. Method 6010 has been employed for solid samples and Method 6020 has been employed for aqueous samples.

72. Worksheet #28, General - For sediment samples, Worksheet #28 is missing for low concentration VOCs and sediment oxygen demand.

    Response: Worksheet #28 has been updated.

73. Worksheet #28, General - There was NO ammonia wet chemistry Worksheet #28 for surface water, but there was one for Worksheet #12.

    Response: Worksheet #28 has been updated.

74. Worksheet #28, pages 630-792 - In many cases, there were errors in the entries for the analytical groups in the QC Sample tables. For example, on pages 643 and 645, "PCB Aroclors" should be entered instead of "GC." In addition, there were double titles in QC Sample tables (for example, see page 754). Furthermore, there were inconsistencies in the listed matrices between the table of contents and the QC tables. For instance, in page 661, tissue was listed for SVOCs in the QC table, but was NOT listed in the table of contents.

    Response: Worksheet #28 has been updated.

75. Worksheet #28, pages 630-793 - This worksheet includes a table of contents for Worksheet #28. It would be helpful to the reader if the sample methods were also listed in this table.

    Response: Worksheet #28 has been updated to include this information.

76. Worksheet #28, pages 630-793 - The specific method/SOP containing the QC acceptance limits should be cited in the third column of Worksheet #28, and the Measurement Performance Criteria should be listed in the last column. The Measurement Performance Criteria listed in Worksheet #28 must be consistent with the Measurement Performance Criteria in Worksheet #12. These criteria must be consistent with the QA acceptance criteria which the laboratories will follow in their SOPs.

    Response: Worksheet #28 now contains all requested information.

77. Worksheet #28, page 633 - For the Test America (Pittsburgh, PA) laboratory, TSS was required for water samples, but was NOT listed in Worksheets #12 and #15. In addition,

sediment oxygen demand was also NOT listed in Worksheet #15, but was listed in Worksheet #12 (page 43) and Worksheet #28 (page 633).

Response: Worksheet #28 has been updated to include this information.

78. Worksheet #28, page 773 - Please list out analytical methods for radionuclides instead of referring to the SOP.

Response: Worksheet #28 has been updated to include this information.

79. Worksheet #29, pages 793-794 - Project Documents and Records – The list of records is incomplete. Examples of items which should be included are field notes/logs, chain of custody reports, analytical data deliverables, QC check lists, technical system audit reports, data validation reports, and the final summary report. How will the analytical data be stored and in what format? The project data should be available in an electronic format, meeting EPA Region 2 requirements.

Response: The list of records in Worksheet 29 already includes all of the items listed in the comment. No change is required. Analytical data will be stored electronically in the project Database Management Systems (DMS), a SQL Server database accessible through a Microsoft Access front-end application and through a security-controlled website. Analytical data will be submitted electronically to the EPA following the guidance described in the Electronic Data Deliverable (EDD) Comprehensive Specification Manual V1 (USEPA. January 2008), or more recent versions as they are released. This document is contained in Appendix A of the Data Management Plan, which describes the method of data submittal.

80. Worksheet #30, pages 796-808 - Analytical Services – Please explain why many of the concentration levels are listed as medium/high. Is there evidence that low levels analyses will not be necessary? The Final QAPP should specify whether CLP or non-CLP methods will be employed instead of offering so many options. Other labs and methods should be considered if these are not capable of supporting the project action levels (see previous comments on Worksheet #15).

Response: The QAPP has been revised to specify non-CLP analytical methods, pursuant to the January 21, 2009 meeting with EPA.

81. Worksheet #31, pages 809-810 - Planned Project Assessments – External technical system audits of the field sampling are also recommended. Consider documenting lab certifications.

    Response: A technical system external audit has been added to Worksheet #31.

82. Worksheet #34, page 822 - Describe the EDD further. Will this be processed by the lab or the data validator using the software mentioned in Worksheet #36?

    Response: A description of the EDDs has been added to the Worksheet. The EDDs will be developed and provided by the laboratories. EDDs will be text files and include, at a minimum, all required data fields described in the EPA Region 2 electronic data guidance (Electronic Data Deliverable (EDD) Comprehensive Specification Manual V1, United States Environmental Protection Agency. January 2008). Where the laboratories are set-up to do so, EDDs will include all fields described in the guidance. Concentration and detection limit data will be delivered as string (as opposed to numeric) field types to ensure that the precision (i.e., number of significant digits) intended by the laboratory is represented in the EDDs.

    The EDDs will be processed first by a database manager using the software mentioned in Worksheet #36, and then outputted from the Data Management System (DMS) in a format for use by data validators (see the Data Management Plan for further details on this process).

83. Worksheet #35, page 827 - This worksheet states that "NEAP accreditation supports the requirements of the QAPP." Does this only apply to chemistry parameters? Please confirm that the laboratories are certified for all the parameters.

    Response: Worksheet should refer to "NELAC" accreditation. Clarification has been provided in the QAPP.

84. Worksheet #36, page 829 - This worksheet states that "Field data will also be validated against the standard operating procedures and the acceptance criteria contained in the project specific UFP-QAP." Please confirm that measurement performance criteria and QA criteria are included in the QAPP worksheets for the field test measurements.

    Response: The information has been included in the QAPP as applicable.

85. Worksheet #36, page 830 - This worksheet mentions electronic deliverable screening software. Please describe this validation software in more detail. What will be the input and output? What criteria will it check against? Who will review the output?

Response: The worksheet has been revised to include this information. The electronic deliverable screening software is also described in detail in the Data Management Plan.

86. Appendix B, Section 2.2, page 2-2 - If observations from the point discharge reconnaissance (Task 1A) show that flow from East Riser is more significant than expected, it is suggested that an additional moored hydrodynamic/water quality station is installed between Peach Island Creek and East Riser.

Response: No change required. Modification of the hydrodynamic program has been evaluated throughout the system based on the findings of Phase 1. [Note that the above-cited condition is considered highly unlikely based on numerous observations of East Riser flow conditions.]

87. Appendix B, Section 2.3, pages 2-4 and 2-5 - Need clarification: The 29 mobile monitoring locations consist of 24 points and 5 across-channel transects (with up to 10 points).

Response: Clarification has been made.

88. Appendix B, Section 2.3, page 2-5/Figure B-6 - The text indicates that at moored locations, additional monitoring would occur across a channel transect. In Figure B-6, the transect on the long-term ADCP is shown parallel to the shoreline not across the channel.

Response: An adjustment has been made.

89. Appendix B, Section 3.1, page 3-1 - Automated sampling is to be done in 5 locations. However, there are only 4 locations shown in Figures B-3 through B-6. The legend on the figures should be revised since the symbols used for surface water and ADCP long term are the same. However, the symbol for long term ADV is different; therefore, only 4 stations are shown in the figures instead of 5.

Response: An adjustment has been made.

90. Appendix B, Section 4, General - Sediment sampling should also be included in marsh/wetland areas since these areas are suspected of having the highest rate of net deposition (refer to Figure 5-13 in Work Plan). These areas are also habitat for mummichog, which can migrate from marsh to waterways (refer to Figure 5-4 in Work Plan) and should be evaluated.

    Response: See response to the general comment #1 on the Work Plan.

91. Appendix B, Section 4.3, page 4-2 - The locations of core sampling should be better distributed for LBC (Figure B-3).

    Response: No change. The rationale for the sampling locations has been provided in Section 8.1.3.3 of the Work Plan.

92. Appendix B, Section 4.3, page 4-2 - Radioisotope parameters [(Cs-137, Pb-210 (not including Be-7)] should be analyzed for all cores that are analyzed for COPCs and related parameters. In other words, radiological analysis and chemical analysis have to be from the same core. If an additional core is collected to make up volume for analysis, then radiochemistry should be taken for that core as well.

    Response: Pursuant to the discussion at the January 22, 2009 meeting with EPA, the Group will minimize the number of cores to the extent practicable and has provided a grouping of analytes that will be taken from the same core, whenever multiple cores are necessary.

93. Appendix B, Section 5.3, General - Suggest including an additional all biota sampling point at the lower end of MBC near Rutherford Marsh and Walden Swamp.

    Response: Pursuant to the discussion at the January 22, 2009 meeting with EPA, no revision of the Phase 1 biota sampling points is necessary.

94. Appendix B, Section 5.3, page 5-4 - The Work Plan states that mummichog is also present in marshes and can migrate between waterways and marsh depending on hydrologic conditions (refer to Figure 5-4 in the Work Plan). Mummichog samples should also be obtained from marsh areas.

    Response: Mummichog sampling in the marshes will be evaluated as part of the Phase 2 scope of work. No change.

95. Appendix B, Section 5.3, page 5-4/Figure B-3 - The text indicates that mummichog would be sampled in smaller waterways. The list of waterways shows Fish Creek as one of the waterways; however, in Figure B-3 there is no mummichog sampling shown for Fish Creek.

    Response: No change. The need for additional mummichog sampling will be assessed for Phases 2 and 3 after Phase 1 results are evaluated.

96. Appendix C, SOP 3.2,General - From the SOP, it is understood that core/sediment processing would occur on the boat. Processing in a constrained space may increase the potential for cross-contamination between samples. It is suggested that samples are taken to a field facility and processed there.

    Response: The SOP has been revised to describe the likely approach, which includes land-based processing of most Phase 1 samples.

97. Appendix D, General - Lab SOPs - Since this is a very large document, a table of contents should be added so the reader can locate each SOP. Suggest that the order of presentation of the test method SOPs be in the same order as in Worksheet #23 "Analytical SOP References."

    Response: Agreed. A table of contents has been added.

98. Appendix E, General - Environmental conditions are not "stressors" to a system. DQOs state that salinity and temperature are stressors to Berry's Creek. Salinity and temperature are environmental conditions.

    Response: The text of the DQO introductory sections has been revised where applicable to explain that human activities (e.g. water diversions and power plants) have and continue to cause unnatural salinity and temperature conditions that influence the distribution and abundance of plants and animals in the BCSA. Therefore, they are stressors, consistent with EPA guidance that is referenced in the documents.

99. Appendix E, General - Introductory text of the DQO tables is confusing and cumbersome. Remove introductory text and incorporate information (as well as comments) into DQO tasks.

    Response: The introductory text was reviewed and revised for clarification. This

text primarily serves to provide DQO step content that is common to all subtasks described in the table to reduce duplication.

100. Appendix E, Table 1 (page 1) - Step 4 and 6: Hydrological monitoring needs to occur on timescales longer than 1 year to capture major storm events that transport solids.

Response: No Change. Hydrodynamic program will be continued in Phase 2 and likely in Phase 3.

101. Appendix E, Table 1 (page 1) - DQO focuses on measuring flow during non-storm, low flow conditions. These conditions are ideal for groundwater monitoring - however, groundwater does not transport solids. DQO need to focus on surface water flow and capturing high flow rain events.

Response: This comment is addressed by the Task 1 scope of work. No change.

102. Appendix E, Table 1 (page 3) - Task 1A: A sufficient amount of TSS data needs to be collected to calibrate the sensors. The proposed quarterly sampling is not sufficient; correct calibration requires extensive sampling in the first month with subsequent monitoring to back-check sensor calibration.

Response: No change required. Extensive calibration will be performed during the initial mobile/ transect monitoring, and will be repeatedly verified during each quarterly event.

103. Appendix E, Table 1 (page 3)- Task 1A, Step 5: For the "if-then" statement, quantify the term "significantly different". How far off will the volume estimate need to be before they are recalculated?

Response: This change has been made.

104. Appendix E, Table 1 (page 3) - Task 1A, Step 6: Statement on uncertainty is not founded since the Berry's Creek is a small-scale system, and flow can be estimated by precipitation and drainage area.

Response: Reviewed and no change is necessary at this time.

105. Appendix E, Table 1 (page 4) - Task 1A, Step 6: DQO states that if the uncertainty analysis is "significant," then data collection will be considered in Phase 2. The Work Plan text (Section 8.2) should include discussion of anticipated Phase 2 data collection.

Response: Reviewed and no change is necessary at this time.

106. Appendix E, Table 1 (page 4-5) - Task 1B/1C, Step 2: Add a study question for marsh exchange (e.g., are marshes asking as a source, sink, or both).

Response: An additional study question on marsh exchange will be added when scoping the Phase 2 work, which includes evaluation of the exchanges between the marshes and waterways.

107. Appendix E, Table 1 (page 5) - Task 1B/1C, Step 5: DQO discusses Phase I sampling using moorings and water quality stations to understand marsh/waterway exchange. However, sediment sampling of marshes will occur in Phase II. To understand impacts of marshes, sediment and water quality should be both sampled in Phase I.

Response: Pursuant to the January 22, 2009 meeting with EPA, no change is needed to address this comment.

108. Appendix E, Table 1 (page 8) - Task 1E, Step 2: Contaminant transport by absorption and adsorption depends on surface area of particle as well as organic carbon content. The important of absorption into organic matter needs to be included in the problem statement, study question, and field program.

Response: This comment is addressed in the surface water program development in the Work Plan in Section 8.1.2. The DQO has been modified to reflect this.

109. Appendix E, Table 1 (page 11) - Task 1F, Step 1: DQO states that riser ditches drain 48 percent of the watershed; however, limited sediment and surface water sampling is planned on the riser ditches. Sampling program needs to be re-developed to answer study questions and problem statement.

Response: The Riser Ditch sampling program has already been discussed with EPA and agreed upon.

110. Appendix E, Table 2 (page 4) - Task 2A, Step 7: Sampling program includes a 2-week composite sample. Preservation methods are not clearly described as well as discussion on equilibrium issues in particular for preserving dissolved-phase constituents.

Response: The table has been clarified to explain trade-offs and considerations.

111. Appendix E, Table 2 (page 6) - Task 2B, Step 5: DQO for Manual Modified Quarterly Sampling infers that risk-based thresholds will be considered in Phase 1 during the data interpretation. During Phase 1, all data need to be considered to develop future sampling programs.

Response: Agreed. The DQO has been modified to reflect this.

112. Appendix E, Table 2 (page 7) - Task 2C, Step 2: The study question is focused on creating a time-integrated (15 hour) sample. Discussion is necessary for identifying storms that are appropriate for this high-flow, 15-hour event to avoid sample dilution.

Response: The rationale for the approach has been clarified, consistent with the meeting on January 22, 2009.

113. Appendix E, Table 2 (page 1) - Task 2D, Step 5: A contingency plan for sampling storm events is not presented. Further description is needed to describe a "qualifying" storm event. What factors will be considered to determine mobilization for manual storm sampling.

Response: The table has been revised (Step 7).

114. Appendix E, Table 3 (page 1) - Step 4: DQO states that radiological cores are designed to characterize the 1960 time horizon (e.g., 50 years ago). Contamination in Berry's Creek extends farther back in time than the 1960s. The cores must extend beyond the 1960 time horizon in order to be sure that the radiological peaks are found.

Response: The table has been revised to provide clarification of the additional basis for the Phase 1 approach to cores.

115. Appendix E, Table 3 (page 1) - Step 6: DQO notes that soft sediment may pose challenges for sampling. Soft sediment cores need to be processed vertically so samples can be collected and compression can be monitored.

Response: Acknowledged.

116. Appendix E, Table 3 (page 3) - Task 3A, Step 7: The biological active zone (BAZ) requires a depth variance. Statistically, a minimum of 20 sampling locations for SPI will be required (per zone) to determine the mean and variance on the BAZ depth.

Response: The rationale for the approach was discussed at the January 22, 2009 meeting with EPA.

117. Appendix E, Table 3 (page 4) - Task 3B, Step 2: Study questions for the BAZ discuss comparison to risk-based thresholds and Phase 2 planning. The Phase 1 sediment program needs to focus on understanding the system, nature and extent, and contaminant loading.

Response: The objectives for the Phase 1 work have been clarified throughout the documents.

118. Appendix E, Table 3 (page 6) - Task 3C, Step 7: Sediment cores need to be collected at all sampling locations. One sediment core is collected at each location and analyzed for chemistry and radiological parameters. Cores need to be processed in a continuous process so that each sediment sample has a chemical and radiological result.

Response: The rationale for the coring scope has been discussed in Section 8.1.3 of the Work Plan. Concerning the analytical program, please see response to Work Plan Specific Comment #1.

119. Appendix E, Table 4 (page 1) - DQO needs to include the sampling of phragmites (especially roots) to understand impacts of phragmites on contaminant fate and transport and impacts on the food web.

Response: Phragmites sampling is a Phase 2 activity and the DQO will be presented at that time to match the proposed work.

120. Appendix E, Table 4 (page 4) - Task 6A, Step 7: The number of sampling locations are unclear. DQO states that 4 sampling locations will be established on the main stem of Berry's Creek (plus two additional "deep pool" locations). Criteria for selecting these locations is unclear. Sampling locations above the tidal gates need to be added.

Response: The rationale for sampling distribution has been clarified. Aquatic

survey is not proposed above the tide gates, because the primary focus of the study is within the tidal portion of the BCSA.

121. Appendix E, Table 4 (page 4) - Task 6A, Step 7: Surveys should occur for all 4 seasons to understand and characterize the ecosystem.

Response: As described in Section 8.1.6.1, biotic surveys will be conducted once during the spring, summer, and fall seasons to evaluate seasonal variability during the period of highest abundance and diversity (summer).

122. Appendix E, Table 4 (page 5) - Task 6B, Step 7: Surveys should occur for all 4 seasons to understand and characterize the ecosystem.

Response: As discussed and agreed upon at the January 22, 2009 meeting with EPA, Task 6B is no longer proposed. The Work Plan and QAPP have been revised accordingly.

123. Appendix E, Table 4 (page 6) - Task 6C, Step 2: Study questions are developed to identify a spatial correlation between sediment and mummichog concentrations. To correlate sediment and mummichogs, a sufficient sediment density needs to be established to capture a comparable area that the mummichogs integrate over. Rationale and calculation on sediment and mummichog locations and density are not provided.

Response: This comment is addressed in the Work Plan in Sections 8.1.3 and 8.1.6.

124. Appendix E, Table 5 (page 5) - Task 8C, Step 7: Sampling program for the reference areas is not appropriate. Three sampling locations per reference area will not provide sufficient coverage to characterize the reference area.

Response: The text in Appendix E and in the Work Plan (Section 8.1.8) has been revised to reflect the fact that the findings from the Phase 1 program will be used to refine and focus Phase 2 characterization efforts at selected reference sites. Additionally, the survey of field parameters in each of the candidate reference areas will be used to aid in the selection of sample locations (surface water, sediment and biota) and to evaluate if additional sample locations are needed in Phase 1 to compare the reference areas.

125. Appendix G, General - Why are different versions of the SW-846 methods being compared for the same parameter (e.g., 6020 vs. 6020A)? Unless there is a technical reason why a lab must follow an older version of an analytical method, they should be requested to follow the most recent version of the applicable test method. If necessary to meet the project action levels, non-EPA methods can also be specified as long are they are fully documented, have been demonstrated for the matrix, include adequate quality control, and the laboratory processes the necessary qualifications.

    Response: Appendix G has been removed from the QAPP since the tables focused primarily on evaluation of CLP methods.

126. Appendix G, page 1, CN - Methods Comparison Table - Please include an introduction describing the purpose of this appendix and a table of contents. Please confirm the all the QC/QA criteria presented in the tables in Appendix G are the same as the criteria and limits in the QAPP worksheets and in the associated laboratory SOPs.

    Response: Appendix G has been removed from the QAPP since the tables focused primarily on evaluation of CLP methods.

127. Appendix G, page 1, CN- Methods Comparison Table - In the footnote referencing the "Methods Development Work Plan," the location of the document should be provided. The Draft QAPP reader/reviewer should have access to the "Methods Development Work Plan."

    Response: Appendix G has been removed from the QAPP since the tables focused primarily on evaluation of CLP methods.

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Princeton, NJ

April 28, 2009

-Via Email and Regular Mail-

Mr. Douglas Tomchuk
USEPA, Region 2
290 Broadway
New York, NY 10007-1866

RE: Berry's Creek Study Area – RI/FS – Response to April 9, 2009 Agency Comments on the Revised Work Plan and Quality Assurance Project Plan (QAPP)

Dear Mr. Tomchuk:

Environmental Liability Management is submitting this response to the USEPA comments on the Revised Work Plan and QAPP on behalf of the Berry's Creek Study Areas (BCSA) Cooperating Parties PRP Group (Group) in accordance with the May 5, 2008 Administrative Settlement Agreement and Order on Consent (Settlement Agreement) for the Berry's Creek Study Area Remedial Investigation and Feasibility Study (RI/FS). Below is a response to each of the agency comments that indicates how the comment has been addressed. Under separate cover, you will receive four paper copies and one electronic copy of the revised pages of the March 12, 2009 version of the Work Plan and QAPP for the BCSA Remedial Investigation and Feasibility Study (RI/FS). The revised pages are limited in number compared with the size of the documents. As such, the materials provided are replacement pages for the Work Plan and the QAPP. Please replace pages in your March 12th copy with these finalized pages. Due to the minimal changes, we have not included a red line version but can do so at your request.

REVISED WORK PLAN (WP) COMMENTS

WP Comment 1: *The revisions to the Work Plan did not really address the agencies' comment that the Work Plan does not convey an accurate history of industrial discharges. Although EPA will not require a change at this time, the Agency believes such information is helpful in* *understanding the system and may include the names of parties in documents prepared by the Agency.*

WP Response 1: So noted. No change required.

WP Comment 2: *The response to Comment 127 referenced that the BERA Work Plan will address issues with BAFs and BSAFs or the potential need for a biouptake model. This is not just a BERA issue; it is an overall fate and transport issue and potentially a modeling issue.*

WP Response 2: Agreed. No change required.

WP Comment 3: *The proposed revision to Study Question 13 is worse than before. Please delete this study question.*

WP Response 3: Study Question 13 has been deleted from the Work Plan. All pages referencing Study Question 13 have been updated. Table 5-2 has been updated to include only Study Question 1 through 12.

Note: A revised cover and cover page have been included to show the date of submission of this letter and revised pages. The new date on the cover is April 28^{th}, 2009.

REVISED QUALITY ASSURANCE PROJECT PLAN (QAPP) COMMENTS

QAPP Comment 1: *QAPP/FSP Worksheet #6, Communication Pathways, page 26 of 515 - Microbac Laboratories and the associated responsible personnel should also be included if there are issues related to data quality, including inability to meet reporting limits.*

QAPP Response 1: Worksheet #6 has been updated to include Microbac information.

QAPP Comment 2: *QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 202 of 515 – for the PCB analysis in surface water, it should be noted that the fresh water project action limit is well below the project quantitation limit and the achievable lab limits. The worksheet should include some footnote information to indicate that if there is a need for PCB information to meet the fresh water project action limit based on the overall data evaluation* *from this phase of the study, a more sensitive method will be considered. This comment also applies in general to other analytes that have achievable lab limits that are higher than the project action limits.*

QAPP Response 2: A sentence and footnote have been added to the preamble to Worksheet #15 stating that more sensitive methods are available should the data evaluation from Phase 1 indicate that lower detection limits are warranted for particular analyses.

QAPP Comment 3: *QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 219 of 515 – Based on the Tables 1 and 2 at the end of Worksheet #15, the mercury project action limits listed for the marine sediment and the fresh water sediment were switched. Please verify the information presented.*

QAPP Response 3: The mercury project action limits were reviewed and corrected.

QAPP Comment 4: *QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 223 of 515 – The listed values for both the human health based project action limits and ecologically based project action limits for methyl mercury did not match the information provided in Tables 1 and 2.*

QAPP Response 4: The methyl mercury information was reviewed and corrected.

QAPP Comment 5: *QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 212 of 515 – For the lipids determination in tissue samples, it is not clear why the MDL and Method QL information would refer to Method 8290.*

QAPP Response 5: The MDL and Method QL information refers to Method 8290 because the lipid content determination is contained in Section 6.7 of the referenced method. No change required.

QAPP Comment 6: *QAPP/FSP Worksheet #28, Laboratory QC Samples, page 374 of 515 – The matrix listed in this worksheet did not include tissue samples.*

QAPP Response 6: Tissue was added to the matrix description for the pesticide analysis laboratory quality control on page 374.

QAPP Comment 7: *QAPP/FSP Worksheet #36 Steps IIa and IIb Validation Summary – Only the customized Tier II validation checklist was provided for Method 8270. All the Tier II validation checklists/SOPs that will be used should be provided with the project documentation for review.*

QAPP Response 7: EPA Region 2 Validation Guidance SOPs will be used for validation criteria in conjunction with the customized Tier II check lists which were developed based on Region 2 validation guidance, specific laboratory SOPs, and the EPA Methods referenced by the laboratory SOPs. The remaining checklists have been developed and are provided, along with the EPA Region 2 SOPs. (Laboratory SOPs are already provided in the QAPP.)

OTHER

Worksheet Numbers 19 and 30 have been slightly revised and thus are provided. Revisions were due to minor errors that were noted and additional laboratory information that was identified after the initial submission of the QAPP for USEPA review.

The specific changes that were made to Worksheet Number 19 included:

- Elimination of sodium bisulfate for low level EPA Method 8260 sediment samples, addition of an extra DI water volatile organics analysis (VOA) vial and a change of the holding time to 48 hours.
- Revised of the holding time for phosphate analysis to 48 hours.
- Revised mercury and methyl mercury water and methyl mercury sediment preservation and holding time criteria.
- Revised method listed for percent moisture of tissue samples.

The specific change that was made to Worksheet Number 30 was listing TA-North Canton as the primary laboratory for metals analysis, including low level mercury and methyl mercury analysis.

Please do not hesitate to contact me if you require further clarification.

Sincerely,
ENVIRONMENTAL LIABILITY MANAGEMENT, INC.

Peter P. Brussock, Ph.D.
BCSA Project Coordinator

C: Gwen Zervas, NJDEP (three copies)
William Sy, USEPA, Edison, NJ
John Hanson, Esq., Beveridge and Diamond, P.C. (w/o attachments)

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July 27, 2010

-- Via E-Mail and FedEx --

Mr. Doug Tomchuk
USEPA
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: Berry's Creek Study Area (BCSA); Responses to USEPA Comments on the Phase 2 Work Plan and Quality Assurance Project Plan (QAPP) Addendum; Request for Partial Approval of the Phase 2 Work.

Dear Mr. Tomchuk:

The BCSA Group has received comments from the USEPA on the Phase 2 Work Plan Addendum (June 7, 2010), QAPP Addendum (June 7, 2010) and Phase 1 Report (June 11, 2010). As discussed with you during the last few weeks, the BCSA Group has been reviewing these comments, preparing responses, and revising the Phase 2 Work Plan and QAPP Addendum to facilitate USEPA approval of the seasonally dependent work (e.g., biota and related surface water and sediment characterization), while the details of the remaining work (e.g., Phase 2 hydrodynamics and sediment dynamics evaluation) are worked out with the USEPA in response to the comments on those elements of the work.

Attached are the USEPA comments on the Phase 2 Work Plan Addendum (Attachment 1) and QAPP Addendum (Attachment 2) with a response to each comment. These responses also took into account the Phase 1 Report comments. A response to the Phase 1 report comments is being prepared and will be submitted separately with some supplemental materials (e.g., a comprehensive set of figures indentifying showing the locations of known hazardous sites (CERCLA and others), landfill areas, former POTW outfalls, etc.). The Phase 1 comments and responses will be further addressed in future deliverables including the Phase 2 Report, Pathway Analysis Report and the Modeling Plan. In addition, the BCSA Group anticipates meeting with the USEPA regarding some of these comments and responses.

To facilitate the collection of seasonally dependent (summer) Phase 2 data, the BCSA Group is requesting partial approval of the tasks and subtasks related to biota sampling and the co-located surface water and sediment sampling that is integrated with the biota work. The surface water/ground water interaction studies are also included in this request for partial approval because the construction and development of the monitoring wells will take time and no changes in the scope are necessary to address the USEPA comments on this task. A list of Tasks and Subtasks for which partial approval is requested is presented as Attachment 3.

In addition, the BCSA Group notes that some of the surface water and sediment sampling locations have been shifted in response to comments regarding potential on-going sources and some sampling points were added or redirected to locations where more elevated concentrations of some COPCs were observed in Phase 1. The redirected samples include some samples that were proposed for Ackerman's Creek and Marsh but were subsequently determined to be redundant with samples recently collected for the UOP Site work. Those new sample locations are shown on the Plates attached to the Phase 2 Work Plan Addendum responses to comments and will be shown on the figures in the revised documents.

The early approval work does not include work related to Tasks and Subtasks such as:

- Hydrodynamics and sediment flux measurements;
- Deep cores;
- Collection of radioisotope data; and
- Storm event sampling.

The scope of the latter activities is being re-evaluated in light of the many USEPA comments on these topics (see response to specific comment #1 in the Phase 2 Work Plan responses to comments).

If this approach is acceptable to the USEPA, revisions to the Phase 2 Work Plan Addendum and QAPP Addendum will be completed for the partial approval Tasks and Subtasks, consistent with the attached responses to comments. These revised documents will be submitted to the USEPA for review and approval on expedited basis. While the responses to comments and revised documents are under USEPA review, the BCSA Group consultants will initiate staging and some field activities, in consultation with the USEPA, in preparation for the collection of the samples for laboratory analyses given the limited time remaining this summer following the extended agency review period of the subject documents. Similar to the Phase 1 field work implementation, the BCSA Project Coordinator and RI/FS Contractor will update the USEPA on a weekly basis of the pending field activities.

Regarding the Tasks and Subtasks not requested for partial approval, a supplemental Phase 2 Work Plan and QAPP Addenda will be submitted after meeting with the USEPA in a work session (scheduled for August 4, 2010) to discuss the agency comments and revise the scope of Phase 2 work for those elements of the RI. That scope of work will be implemented immediately upon USEPA approval.

Please contact me if you have any questions regarding this approach or the attached materials.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

PPB:ng

Attachments

c: Gwen Zervas, NJDEP
John Hanson, Esq.

ATTACHMENT 1
LETTER TO DOUG TOMCHUK, JULY 27, 2010
PHASE 2 WORK PLAN ADDENDUM – RESPONSE TO COMMENTS (RTC)

General Comments

1. *The finding of elevated manganese at elevated levels in more recently deposited sediments warrants additional discussion. The agencies are unaware of any "new" sources of manganese which would be responsible for this phenomenon. Could this related to changes in oxygen levels in Berry's Creek coincident with improved sewage treatment? Perhaps comparison of manganese levels in the Berry's Creek ecosystem with more healthy oxygenated estuarine systems is warranted.*

Response: Review of the data identified some potential manganese source areas that will be evaluated further in Phase 2 (e.g., outfalls in upper Peach Island Creek and east side of Eight Day Swamp). In addition, as noted in the Phase 1 report (Section 2.3.3.3, p. 2-4), manganese would preferentially accumulate in more oxygenated sediment areas, such as the less frequently inundated portions of marshes. This relationship will be evaluated further when the Phase 2 marsh data are available, including the exchange of surface water between marshes and waterways, as well comparative analysis with the reference areas which have varying degrees of sewage effluent influences.

2. *The current sediment sampling effort does not seem to support the evaluation of potential interim remedial measures (IRMs) or early actions as discussed in the Settlement Agreement. The scope of the work for Phase 2 seems predisposed toward not requiring an early action. It is understood that any early action would require design sampling to further delineate areas that are targeted, but the current plan does not include sufficient information to delineate general areas to target.*

Response: The number of samples being collected in Phase 2 will substantially increase the information on the waterways and marshes to determine the general concentration gradients and variations within all study segments (see RTC Table 1). Some engineering parameters (e.g., shear strength and Atterberg limits) are being collected during Phase 2 work to support the screening of alternatives. The SOW specifies an evaluation of IRMs or early actions following Phase 2 taking into account the risk assessments completed up to the time of the IRM. If appropriate, the IRM letter report will present potential remedial options and plans to reduce human health and ecological risks. Targeting specific areas (e.g., within individual marsh areas) for delineation to support IRM or early actions is beyond what is required pursuant to the SOW for Phase 2. However, a more focused delineation of some subareas may be warranted, in consultation with the USEPA, as a separate sampling event following Phase 2 and prior to the Phase 3 work to support the finalization of the IRM letter report evaluation.

3. *The selection of COPCs seems to be appropriate overall, as long as enough data is collected, in the correct media, to evaluate risks for COPCs that exceed screening*

RTC TABLE 1 - RESPONSE TO GENERAL COMMENT #3
SUMMARY OF THE NUMBER OF SAMPLE LOCATIONS AND PERCENTAGE OF LOCATIONS WITH SAMPLES ANALYZED FOR THE FULL PARAMETER LIST FOLLOWING PHASE 2

Segment	Summary of Sample Locations								
	Surface Water			Sediment					
				Waterways			Marsh		
	Phase 1	Phase 2	% Full Parameter List[1,2]	Phase 1	Phase 2	% Full Parameter List	Phase 1	Phase 2	% Full Parameter List
Risers	6	2	75%	12	0	100%	--	--	--
UBC	10	28	34%	52	52	57%	8	16	29%
MBC	13	22	40%	50	33	70%	10	14	25%
BCC	5	4	67%	37	2	95%	3	10	23%
LBC	10	6	69%	59	27	70%	3	11	29%

[1] Percent of total sample locations (P1 + P2) where at least one sample increment has been analyzed for the full analyte list.

[2] Full parameter list includes metals, PCBs, mercury, methyl mercury, VOCs, SVOCs, pesticides, BOD, COD, AVS/SEM, sulfides, sulfate, TOC, grain size, CEC, and % moisture

- Note that the UOP Site has completed additional, extensive sampling of sediments and surface water that is not included above.
- Phase 2 marsh counts do not include methylation/demethylation cores or Phragmites samples as these are special analyses that are co-located with COPC work.

criteria. It is important that the full parameter subset is not biased just to locations that provide greater sample volume. The Phase 1 Report comments (to be provided next week) will have additional comments on the COPC screening process.

Response: All of the Phase 1 surface water and sediment samples were analyzed for the full parameter list. While sufficient sample volume is a logistical consideration for complete analyses, the locations of Phase 2 samples for the full parameter list were selected primarily to support the risk assessments (e.g., exposure point concentrations). In addition, some of the samples are targeted to potential continuing source areas and a few will be collected from deeper marsh sample intervals. Attached to this response to comments are four plates that designate locations where the surface water and sediment samples will be collected for the full parameter list as described in the Phase 2 Work Plan Addendum. In addition, RTC Table 1 shows the percentage of sample locations that will be analyzed for the full parameter list following the completion of Phase 2 work.

4. It may be useful to incorporate a figure overlaying the sampling points which have benchmark exceedences with the proposed additional sampling locations.

Response: The four attached plates show the sediment concentrations of COPCs from Phase 1 and the proposed sampling locations for Phase 2. These plates were also included in the Phase 2 Work Plan Addendum. As the COPCs were selected in large part based on concentrations that exceed benchmarks, these plates address the comment.

5. Comments presented regarding the Draft Phase 2 Work Plan also refer to the Field Sampling Plan (Appendix B of the QAPP).

Response: Agreed.

6. In several instances, the Work Plan states that more detail is provided in the QAPP/FSP; however, the reference material is not provided or easily located in the QAPP or Field Sampling Plan. For example, Page 3-23, First Full Paragraph of the Work Plan (Section 3.3.1) states that multiple cores would be collected during Phase 2 from the same sampling location if extra sediment volume is required. The Work Plan then states that prioritization of chemicals is provided in the QAPP/FSP. When the Field Sampling Plan is cross-referenced (Page 4-2), the same wording from the Work Plan is provided (in a "cut-and-paste" fashion) but no information on the prioritization is provided.

Response: The additional detail is being added in the Phase 2 Work Plan Addendum and corresponding sections of the QAPP/FSP.

ATTACHMENT 1
LETTER TO DOUG TOMCHUK; JULY 27, 2010
PHASE 2 WORK PLAN ADDENDUM – RESPONSE TO COMMENTS (RTC)

Specific Comments

1. *Section 2.1, Page 2-1: Phase 2 must include sediment resuspension as a major mechanism for contaminant fate and transport.*

Response: Agreed. Resuspension mechanisms are recognized as an important component of the conceptual site models (CSMs) (Figures 3-27 to 3-31 in Phase 1 Report, February 2010). Based on further review of the Phase 1 data since the submission of the Phase 1 report and Phase 2 Work Plan Addendum, along with consideration of the USEPA comments, the BCSA Group is proposing to take several steps to evaluate the deposition, accretion, resuspension and erosion dynamics throughout the BCSA in more detail going forward. These steps include:

A. Conduct a comprehensive review of the relevant data from the scoping activities (e.g., morphology, bathymetry, sediment profiling) and Phase 1 work (e.g., cores, radioisotope data, turbidity data, sediment flux data) to identify the factors controlling deposition and resuspension using multiple lines of evidence.

B. A re-evaluation of adequacy of the Phase 2 scope of work to assess the deposition, accretion, resuspension and erosion dynamics, as well as sediment flux in the BCSA.

    i. Update the CSMs as necessary to reflect the findings of step A.
    ii. Review the study questions based on steps A and B and revise/add specific related study questions, if appropriate.
    iii. Update the DQOs as needed to clarify how the data will be used.
    iv. Redesign relevant portions of Phase 2 work to provide a robust empirically-based understanding of the sediment dynamics. For example, the sediment flux studies will likely be changed from four short term studies to two longer duration studies to focus the assessment on longer duration major tidal-based storm events and include increased frequency of samples for total suspended solids (TSS) in order to provide higher resolution in quantifying sediment flux in the upper and lower portions of the BCSA.

C. Conduct a work session with USEPA to review the BCSA Group's revised and new CSMs components, sediment evaluation objectives for Phase 2, and proposed scope modifications to support a multiple lines of evidence approach to sediment dynamics characterization.

D. Submit to USEPA a Supplement to the Work Plan Addendum for the new and revised components of the hydrodynamics and sediment flux evaluation.

2. *<u>Section 3, Page 3-4, Top Bullets</u>: The rationale for excluding PCB congeners from the Phase 2 program is weak, and dismisses such analysis primarily for cost purposes. PCB congener analysis is common and often helps support source track down as well as fate and transport analysis. At the same time, PCB congener analysis is not always necessary. Please describe why the BCSA Group has determined that Aroclor analysis will suffice for Berry's Creek, and please describe what information will be omitted by not conducting congener analysis. (This is basically just asking for full documentation of the DQO process that led to the decision to use PCB Aroclor analysis).*

Response: The requested documentation has been added to DQOs. As noted in EPA's Contaminated Sediment Guidance, the need for PCB congener analysis should be based on site-specific considerations. The Group finds that the site-specific data needs to support risk management decisions in the BCSA can be met with Aroclor analysis. Collecting congener data, though potentially providing a more nuanced understanding of PCB fate, composition and potential sources, will not provide any additional data that will be important to the overall evaluation of risks and remedies in the RI/FS.

There are a number of reasons for the decision to use PCB Aroclor analysis as summarized below.

- **Aroclor data match the available toxicity criteria and therefore can be used directly to quantify risks for baseline and remedial alternatives analysis.** The toxicity criteria that will be used to assess human health and ecological risks are based primarily on Aroclor-specific toxicity data. Importantly, for example, EPA has developed cancer slope factors and a non-cancer RfD for PCBs that are based on data for Aroclors. These values are published in EPA's Integrated Risk Information System (IRIS) database. Based on EPA OSWER directives, toxicity values published in IRIS are given first preference for use in risk assessment. No PCB congener-based toxicity values are published in IRIS. Although some congener-specific toxicity data are available in the general literature, not enough is available to fully characterize risks based on congener data alone. Alternate proposals to use toxic equivalency (TEQs) for a subset of PCB congeners termed dioxin-like congeners (DLCs) along with the cancer slope factor for 2,3,7,8-TCDD remains unsettled and somewhat controversial within the scientific and regulatory community (Carlson *et al*, 2009; Silkworth *et al*, 2005; GE, 2010) and highly uncertain. For these reasons, the Group concludes that Aroclor data should be used most reliably to assess risks in the BCSA.

Aroclor data will be sufficient to both characterize the nature and the magnitude of baseline risks in the BCSA and to evaluate the risk reductions of potential remedial alternatives.

- **Aroclor data needed for trend analysis and post-remedy monitoring.** Historic PCB data that will be used in long term concentration trend analysis for surface water, sediment and biota is all derived from Aroclor analysis. Consequently, to meet USEPA guidance on evaluation of concentration trends, Aroclor data is required. Also, given analytical issues, cost, and risk interpretability, any post-remedy monitoring will almost certainly be based on Aroclor rather than congener data, as is typical of other sediment sites with PCBs. The Group finds that congener data will not provide information that is useful for establishing the pre-remedy baseline against which post-remedy conditions will be assessed.

- **Congener data would have very limited application in the development and assessment of risk management alternatives for the Site.** Because congener data can be used in the risk assessment process only with a high degree of uncertainty, they would have limited value in the development of risk management decisions for the site. The Group finds that collection of these data will not contribute to risk management decisions at the Site beyond what is provided by Aroclor data.

- **Source identification or allocation is not an objective of the Remedial Investigation.** Congener data can be useful if investigations are being conducted to support forensic evaluations related to source apportionment and allocation. This is not, however, an objective of the RI in the BCSA. The goal of the RI for PCBs is to collect sufficient data to understand the nature and magnitude of the risks posed by PCBs and other substances and to evaluate how those risks might change under different remedial alternatives. Source identification is directed towards on-going sources that can lead to recontamination after a remedial action. In addition, in a well mixed estuary where the primary PCB sources are likely to date back to the 1950s and 1960s, the PCB signatures are likely to be highly overlapping in relation to source areas. Therefore, Aroclor data are adequate to provide the necessary information to achieve risk-related objectives.

- **There is no EPA validated method for performing the PCB congener analysis required to use the TEQ approach for PCBs.** If PCB congener data were collected, risks would need to be evaluated using the TEQ approach noted above. The TEQ approach, by definition, requires analysis of individual DLCs, including PCB congeners that are DLCs. The only method of which we are aware that purports to analyze the dioxin-like PCB congeners is EPA's Method 1668B --Chlorinated Biphenyl Congeners in Water, Soil, Sediment, Biosolids, and Tissue by HRGC/HRMS (Nov. 2008)[1] . Method 1668B has not been validated as called for by EPA's Agency Policy Directive No. FEM-2005-001, Ensuring the Validity of Agency Methods – Methods Validation and Peer Review Guidelines (2005) ("Validation Policy")[2], or FEM Document No. 2005-01, Validation and Peer Review of U.S. [EPA] Chemical Methods of Analysis ("Validation Guidance")[3]. Further, an inter-laboratory variability study of Method 1668A – the immediate predecessor of Method 1668B – conducted for EPA by qualified labs in 2003-2004 indicates that the method is highly problematic[4]. In addition, issues with the methods may be compounded by matrix interferences that vary across the BCSA with salinity high organics (natural and pollutants). Also, the elevated PCB concentrations in a relatively large number of sediment samples and pose analysis problems. The Group finds that the analytical uncertainties surrounding congener analysis will render these data of limited utility to support risk management decisions in the BCSA.

For all of the above reasons, the Group concluded that Aroclor analysis is the better match for the BCSA conditions and congener analysis will not provide additional data that will influence the risk analysis, especially taking into account the substantially increased time and costs associated with analyzing for and interpreting congener-specific PCB data from the difficult sediment matrix in the BCSA. The trade-offs of PCB Aroclor analysis vs. congener analysis has been added to the DQO analysis.

REFERENCES:

Carlson, E.A., C. McCulloch, A. Koganti, S.B. Goodwin, T.R. Sutter, and J.B. Silkworth. 2009. Divergent transcriptomic responses to aryl hydrocarbon receptor agonists between rat and human primary hepatocytes. *Toxicol. Sci.* 112(1):257-272.

Silkworth, J. B., A. Koganti, K. Illouz, A. Possolo, M. Zhao, and S.B. Hamilton. 2005. Comparison of TCDD and PCB CYP1A induction sensitivities in fresh hepatocytes from human donors, Sprague-Dawley rats, and rhesus monkeys and hepG2 cells. *Toxicol. Sci.* 87(2):508-519.

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[1] http://www.epa.gov/waterscience/methods/method/files/1668.pdf

[2] http://epa.gov/osa/fem/pdfs/Method_Validity_Policy_092705.pdf

[3] http://epa.gov/fem/pdfs/chemmethod_validity_guide.pdf

[4] http://www.epa.gov/waterscience/methods/method/files/1668Ato1668B-valdiation.pdf

General Electric. 2010. Draft reanalysis of key issues related to dioxin toxicity and response to NAS comments (75 Fed. Reg. 28610 (May 21, 2010), Docket ID No. EPA-HQ-ORD-2010- 0395. Submitted to T. Armitage, U.S. Environmental Protection Agency, EPA Science Advisory Board Staff Office, Washington, DC. General Electric, Washington, DC. 78 pp. July 9.

3. <u>Section 3, Page 3-3, Table at Bottom of Page</u>: PCB Aroclors were identified as a COPC. The distinction of Aroclors here is inappropriate. The contaminant is PCBs. There are multiple analytical methods that may provide the information necessary to complete the RI/FS.

Response: The COPCs will refer to PCBs, not PCB Aroclors.

4. <u>Section 3.1.1, Page 3-5 (Task 1A)</u>: Each of the hydrodynamic moorings (including the 5 permanent moorings) needs to be equipped with a LISST, ADCP, and OBS since resuspension is a major source of contaminant fate and transport in Berry's Creek.

Response: The collection of data at hydrodynamic moorings is being re-evaluated; see response to specific comment #1.

5. p. 3-5: Section 3.2.2 references Figure 3-5 but it is not clear which symbols are which. This should be clarified by adding MHS numbers to that figure. Particle size distributions (via LISST) are to be measured at two moored stations to be selected based on Phase 1 data—are the ones shown on Figure 3-5 not definite then?

Response: The sample locations presented on Figure 3-5 will be labeled as requested. Based on the Phase 1 results, LISST meters will be installed to measure particle size distribution at locations MHS-01 (BCC) and MHS-06 (UBC), as shown on Figure 3-5; subject to any revisions in consultation with the USEPA in response to the review process presented in the response to specific comment #1.

6. <u>Section 3.1.3, pg. 3-6</u> - *It is not clear that the necessary data is being collected to determine the contaminant load associated with the suspended sediments being transported into Berry's Creek from the Hackensack River. Since this is an important driver in determining the regional contribution to the Berry's Creek ecosystem, it should be clearly stated how this component is being measured.*

Response: As noted in the response to specific comment #1, this component of the study is being revised and further detailed. It will be discussed with the USEPA at a work session in early August.

7. <u>Section 3.1.2, Page 3-6 (Task 1B)</u>: TSS/Turbidity Correlations - A major objective in Phase 2 appears to be to quantify solids loading to the system. Of particular importance is the understanding of the net influx of solids that enter the system from the Hackensack River. Multiple studies are proposed to develop a relationship between turbidity measurements and total suspended solids measurements. However, EPA has seen few examples where such relationships have been developed successfully. Given the importance of this information, EPA believes that the Group should conduct sufficient direct measurements of TSS to support the solids calculations required for the project. Additional efforts to develop TSS/Turbidity correlations may be attempted, but they should not be the primary approach to obtain the necessary information. Although we have another phase of field work remaining, part of the reason that the SOW had three years of data collection was the intention to monitor water-column data over several years. The current plan, if unsuccessful would likely not collect sufficient water-column solids information in the three years of field work.

Response: The BCSA Group is adding more direct measurements of TSS to its Phase 2 program, pursuant to the process laid out in the response to specific comment #1.

8. <u>Section 3.1.3, Page 3-6 (Task 1C)</u>: It seems that a program including sediment traps, along with COPC analysis of the trapped sediment, would be beneficial in explaining uncertainties remaining in the CSMs. Please elaborate on why such a program has not been included.

Response: The potential use of sediment traps is being evaluated pursuant to the process laid out in the response to specific comment #1

9. <u>Section 3.1.3, Page 3-7 (Task 1C)</u>: POC measurements must accompany <u>all</u> TSS measurements. More importantly, the POC and TSS measurement must be come from the <u>same</u> filter, so that a clear calculation of carbon load on the solids can be obtains. (For example, TSS cannot be measured on a 1.5 µm filter with a separate POC measurement on a 0.45 µm filter or 0.7 µm filter). These data should be evaluated in concert with COPC results from Be-7 bearing sediment core samples to expand the characterization of sediment transport.

Response: An evaluation of the measurement of POC will be included as part of the process presented in the response to specific comment #1.

10. <u>Section 3.1.4, Page 3-7 (Task 1D)</u>: The dye tracer study will only apply to current hydraulic connections and impacts from tides. The dye tracer study cannot be used to assess "past" conditions since the land use in Berry's Creek has changed.

Response: The dye tracer study results will be primarily applied to the current conditions. However, the information obtained from this study can be used to refine the evaluation of past conditions or potential future conditions if appropriate adjustments are made to best match the changed conditions.

11. Section 3.1.4, pg 3-8 – The narrative should confirm that the Flouroscien dye is not visible to the naked eye in the water column.

Response: The Flouroscien dye will be visible to the naked eye in the water column near the point of release but will dissipate relatively quickly. The narrative was revised accordingly.

12. p. 3-8, Section 3.1.5 - The Ph2 WP calls for the installation of an Acoustic Velocimeter and Profiler to try to measure marsh flow velocities. The maintenance and calibration procedures for these instruments must be included in the QAPP.

Response: Agreed.

13. Section 3.2.1.1, Page 3-10 (Task 2A.01) and Table 3-3: Particulate-phase PCB concentrations should not be calculated by subtracting the dissolved-phase (filtered) concentration from a whole water sample. It is more appropriate to analyze the filtered particulate directly.

Response: The discussion of the conceptual basis and rationale for Task 2A.01 notes the typical association of COPCs with the particulate phase. However, this is not meant to suggest the need to quantify the concentration of COPCs on particulates *per se*, because such an understanding is not necessary for this subtask. This subtask is intended to support estimates of bulk flux of COPCs in tidal ebb and flood cycles; sampling and analyzing total (i.e., unfiltered) aliquots is sufficient for this purpose. We do not plan to subtract filtered concentrations from unfiltered concentrations in this program (in fact, filtered aliquots are not even being collected in Task 2A.01.)

14. Page 3-11, Section 3.2.1.2., first bullet: "For example, correlating mercury or methyl mercury in biota data with surface water mercury/methyl mercury is more valid if the surface water data represent the dissolved, as opposed to the total, fraction." For ecological receptors, the decision to use dissolved versus total metal data should depend on the potential exposure route. The dissolved fraction may be the best measure for an animal that would get the biggest dose from uptake across the gill or through the skin but the unfiltered may be best for an animal that would ingest water.

Response: The ecological risk assessment will take into account the exposure route and whether dissolved or total concentrations are the most appropriate measure of dose.

15. Section 3.2.1.2 Page 3-13: It is noted that the depth will be 0.6 times the water depth below the water surface for all surface water samples; waterways are less than 2.5 feet. Further information should be provided regarding the justification for the selection of 0.6.

Response: The narrative concerning the rationale for the sampling depth will be expanded as follows:

"According to Buchanan and Somers (1969) and Rantz *et al.* (1982), when water depths are less than 2.5 feet, the mean velocity within a given vertical profile of a stream cross-section is observed at 60% of the water depth. H.B.N. Hynes (1970) also concurs with these authors analysis. Rantz *et al.* (1982) also state that under conditions such as changing water depths (which occurs during sampling in the BCSA), the 60% depth method is appropriate for estimating the mean velocity at any particular vertical profile along a waterway. Therefore, the approach of sampling at the 60% depth (0.6 x the water depth at the sample location) will be applied universally as the approximate point of the mean velocity in the water column, consistent with the scientific literature. In light of the well-mixed hydrodynamic conditions as documented in Phase 1, this approach is appropriate for collection of representative surface water samples in the BCSA. Some sampling for sediment flux analysis may be stratified but will be described separately in the Supplemental Phase 2 Work Plan Addendum (See Response to Specific Comment #1)."

REFERENCES:

Buchanan, T.J., and Somers, W.P. 1969. Discharge measurements at gauging stations: U.S. Geological Survey Techniques of Water-Resources Investigations, book 3, chap. A8, 65 p.

Hynes, H.B.N. 1970. *The ecology of running waters.* University of Toronto Press, 2nd Edition.

Rantz, S.E., and others. 1982. Measurement and computation of streamflow—Volume 1. Measurement of stage and discharge: U.S. Geological Survey Water-Supply Paper 2175, 284 p.

16. Page 3-13: The work plan describes the depth of manual water sampling for COPCs. However a discussion should be included regarding where samples will be located in the cross-stream direction (e.g., right at an outfall, or 10m away).

Response: The description of the Phase 2 manual surface water monitoring network cites outfalls in several instances as the rationale for the designation of sampling locations. However, the Phase 2 program is intended to monitor ambient conditions in system waterways and tributaries, with some emphasis on areas in the vicinity of observed outfalls or observed evidence of COPC impacts. Hence, specific details concerning the lateral or longitudinal distance from an outfall to a sampling point have not been presented but are somewhat evident on the figures, including the Plates included with this response to comments (Some key outfalls are identified on the Plate and the corresponding samples are evident.). The cross-stream positioning of surface water samples in waterways is variable. As Figures 3-6 and 3-7 indicate, samples in primary waterways may be close to one or other bank or close to the thalweg; this variability in positioning captures the full range of predicted ambient conditions in the water column of the waterways. It is not attempting to discern relationships between the sediment surface water interface at any particular in the study areas. Similarly, in tributaries, samples will be collected close to the center of the tributary if accessible by boat or close to shore if accessible by land. This range of lateral positions is predicted to be insignificant given the narrow widths of tributaries. Samples collected from land are collected using fluoropolymer tubing extended several feet out from shore with a PVC frame. This reduces the chance of spuriously high turbidity that may be encountered at the streambank in very shallow water.

17. <u>Section 3.2.2.3, Page3 3-18 and 3-19 (Task 2B.03)</u>: The proposed work for measuring particulate-phase contaminants has many potential problems in implementation. EPA believes it is worthwhile to attempt this study, but if the study does not work out as anticipated, the BCSA Group should readily note that the results were inconclusive and not try to use the data for more than it is worth.

Response: The proposed work for measuring particulates will be re-evaluated pursuant to the process presented in the response to specific comment #1.

18. Page 3-19: A duplicate of the entire process should be included so as to evaluate whether the process will provide precision with respect to dividing the particulate material into particle size fractions.

Response: The proposed work for measuring particulates will be re-evaluated pursuant to the process presented in the response to specific comment #1.

19. p. 3-21: The work plan states, "Due to the predominately depositional environment observed in the waterways, an extensive program of deep characterization is not warranted." If there has been a lot of deposition, wouldn't more deep cores be needed to characterize that?

Response: As noted in the Work Plan, deep sediments (greater than six inches below the surface) are stable and not subjected to resuspension, based on the multiple lines of evidence available following Phase 1. In addition, the BCSA is not dredged for navigational purposes. Consequently, the primary depths of concern are where most of the biological activity occurs (the BAZ; top 6 to 10 cm) and the top two feet as the maximum likely depth of evaluation for an excavation action, except the possibility of a localized hot spot where sediment removal may be evaluated, separate from the Phase 2 work.

20. p. 3-22: How was 30 cm selected as the dividing line for segmenting cores? This depth needs to be compatible with plans for transport modeling and risk exposure modeling. Please describe the lines of evidence used to select segmenting intervals.

Response: During Phase 1, sediment samples were collected from the BAZ, BAZ bottom to 15 cm, 15 to 30 cm, and 30 to 60 cm intervals. The Phase 1 results demonstrated that COPC concentrations were generally lowest at the sediment surface (see Figures 2-33, 2-34, and 2-37 through 2-40), and the BAZ to 15 cm and 15 to 30 cm sample intervals did not exhibit substantial differences in concentration (Figures 2-32a-b). The BAZ to 30 cm sample interval proposed in Phase 2 therefore consolidates the previous intermediate sample intervals. In relation to risk exposure modeling needs, the proposed sampling scheme includes sampling of the biologically active zone (BAZ), which was identified based on sediment profile imaging (Appendix C, Phase 1 report) and approved by USEPA. COPC concentrations in the BAZ provide a direct measure of exposure point concentrations, suitable for risk assessment and exposure modeling as needed. In addition, shallow sediment samples (0-2 cm) are proposed for correlation with biota tissue concentrations to support the risk assessment.

With regard to transport modeling, the results of the aerial photograph analysis conducted during the Scoping Activities and the Phase 1 radioisotope sampling indicate that, overall, the BCSA is a physically stable, net depositional environment. However, additional analyses to characterize transport of surface sediments are being proposed by the BCSA Group; refer to the response to Specific Comment #1.

21. <u>Section 3.3.1, Page 3-22 (Task 3A)</u>: Due to the potential for sediment transport due to storm events and anthropogenic activities, the deepest detection of Cs-137 in a particular core may not represent the 1954 horizon (although the sediments are certainly from 1954 <u>or</u> a more recent date) and the peak detection of Cs-137 in a core may not represent 1963 because the 'true' peak sediment may have been eroded or removed at some point. Discontinuous core profiles can confound attempts to estimate deposition rates and additional criteria for evaluation of profiles are required, for example, at least a 0.5 pCi/g detection of Cs-137 to confirm the presence of the 1963 sediment horizon. Changes in the Study Area watershed over history, including the construction of the Oradell Reservoir and increasing upland development, have likely contributed to changes in Pb-210 deposition and are likely to confound attempts to *calculate deposition rates that assume constant deposition.*

Response: The influence of storm events and anthropogenic activities has likely affected the distribution of radioisotopes in the sediments in some locations in the BCSA. The Group is reviewing the several sources of data on the subsurface cores and will include consideration of the history of the events in the Hackensack River basin that have likely influenced the sediment accretion and resuspension over time.

22. <u>Section 3.3.1, Page 3-23, First Full Paragraph</u>: The Work Plan states that multiple cores would be collected during Phase 2 from the same sampling location if extra sediment volume is required. The Work Plan then states that prioritization of chemicals is provided in the QAPP/FSP. When the Field Sampling Plan is cross-referenced (Page 4-2), the same wording from the Work Plan is provided (in a "cut-and-paste" fashion) but no information on the prioritization is provided. (The Work Plan also referenced Table 3-4, but no information on chemical prioritization was provided). Clearly state in Work Plan the proposed prioritization.

Response: The Work Plan and FSP will be modified to indicate the parameter prioritization. The priorities will be as follows: (i) Primary COPCs (mercury, methyl mercury, and PCBs) and key geochronological parameters (radioisotopes, TOC, and grain size), (ii) secondary COPCs (TAL metals), and (iii) remaining parameters.

23. <u>Section 3.3.2, Page 3-23 (Task 3B)</u>: Surface sediment samples [defined as biological active zone (BAZ) samples in the Work Plan] need to include the analysis of Be-7. More important than source track-down is contaminant fate and transport. . In order to evaluate recent deposition utilizing Be-7, a separate program to re-occupy the Be-7 bearing sampling locations from Phase 1 with the collection of a 0-2 cm sediment sample and analysis for Be-7, PCB (congeners?), mercury, and methylmercury should be considered. This would provide better information with respect to the resuspension and transport in the system.

Response: This comment will be considered in the sediment assessment process outlined in the response to specific comment #1.

24. <u>Section 3.3.4, pg. 3-28, 2nd Bullet</u> – It is noted that the fibrous roots of the Phragmites extend to an average depth 76 cm. from the surface, with large roots extending down to an average of 67 cm. Does this zone exhibit different (preferential) contaminant uptake than other zones? There are no sediment samples targeted for this horizon that would help answer such questions.

Response: *Phragmites* tissue sampling is focused on the roots near the sediment surface and above the sediment where receptors might ingest the plant tissue.

Uptake from deeper zones that might be translocated near the surface horizon would be included in the proposed root sample, which would be representative of the potential exposure point concentration. If the concentrations are particularly in the near surface root tissue, the analysis will consider if a substantial contribution may be coming from a depth greater than the sampling depths.

25. p. 3-28: 0-50 cm cores should have COPCs measured at the same intervals as the radioisotopes. It is not clear why only 12 of the 14 location are proposed for radioisotope analysis.

Response: The detailed vertical distribution of radioisotopes (3-4 cm intervals) was selected to meet vertical precision needs that are specific to geochronology. Specifically, it is desirable to sample at a sufficient frequency to capture the ^{137}Cs peak and to generate sufficient data points to populate a robust regression analysis of ^{210}Pb decay. It is not necessary to sample COPCs with this same degree of precision. The four sampling horizons for COPCs were selected to represent four relatively broad timeframes, from recent sediment through the industrial period to pre-industrial conditions, as discussed in the narrative. Characterizing COPC distributions in greater detail will not inform the remedy alternatives analysis to any better degree than the currently planned program.

The slight difference in the number of COPC and radioisotope analyses in marsh cores (14 cores for COPCs, of which 12 are also tested for radioisotopes) reflects the differing degree of variability predicted between the two groups. Based on Weis *et al.* (2005), the historical sedimentation rates within one portion of the study area are predicted to be similar, whereas COPC presence may show some degree of spatial variability due to varying proximities to transport pathways, such as primary waterways or tributaries. Hence, a greater emphasis on COPC locations is warranted. The Group will further evaluate this element of the Phase 2 work as part of the review process described in specific comment #1.

26. <u>Section 3.3.4, Page 3-29 "Scope of Work and Investigative Measures" (Task 3D)</u>: The understanding of contaminant fate and transport that will be provided by conducting the proposed high resolution cores in the marshes should be extended to the creek. Further justification should be provided for why the cores will only penetrate to 16 cm.

Response: The shallow and intermediate sediments proposed for analysis in the high resolution cores represent a substantially higher exposure potential than deeper sediments, and so are the focus of this evaluation. The intent of the high resolution cores is to provide additional insight into the relationship between methyl mercury concentrations and other geochemical parameters that may influence the mercury methylation process at and near the primary exposure points (surface and near surface), given there is a lack of a transport mechanism upward in the marsh with possible exception of movement in plant tissue which is being measured directly.

The Phase 1 results illustrated notable differences in mercury and methyl mercury concentrations between the surface (0-5 cm) and intermediate (10-15 cm) sample depths. The Group anticipates that additional insight regarding the processes responsible for the observed differences will be gained by analyzing samples at 2 cm increments (the smallest practical collection interval, and the reason the cores will extend to 16 cm, rather than the 15 cm core penetration depth from Phase 1 and Phase 2). High resolution cores are currently proposed only in the marshes, because the highest methyl mercury concentrations were observed in the marshes rather than the waterways. However, following more detailed analysis of physical processes that control deposition and resuspension in waterways during Phase 2, a similar type of methylation-demethylation study may be considered for some waterways. Also, the Group will further evaluate this element of the Phase 2 work as part of the review process described in specific comment #1.

27. Pg. 3-32, 2nd para. and pg. 3-33, 3rd para. - Field parameter sampling should also include turbidity.

Response: The Group will consider this comment when completing its sediment evaluation review, as described in the response to specific comment #1.

28. Pg. 3-32 and 3-33 - Will all wells installed during the Phase 2 investigation have an outer locking steel surface casing?

Response: No. These wells will be sealed with a locking cap but installation of an outer steel casing is impractical given their locations and shallow monitoring zones. In addition, these wells are temporary and will be removed after the RI.

29. Section 3.5.1 Page 3-34: Since fish tissue concentration can vary greatly by the sex of the individual, this should be recorded on the final report. Size is also important and should be recorded. The length of the smallest fish in a sample should be ≥ 75% of the largest (EPA-823-B-00-007, November 2000). In general, the size of the fish should be consistent with the size of the prey typically consumed by the receptor of concern.

Percent moisture and lipids must be analyzed for each sample and the sex of each fish used for all samples should be noted in the final report. Regarding white perch, the goal should be individual fish analysis, with compositing only as needed to achieve the requisite tissue mass.

Response: Though the Group recognizes that chemical concentrations in fish can vary by sex, an understanding of the sex-specific concentration of COPCs is of limited value and not needed to support risk management decisions at the Site, given that the receptors that ingest the fish do not preferentially ingest a single sex. For these reasons, the Group concludes that the collection of sex-specific fish tissue residues is not needed or warranted. For the record, however, the Group would like to note that the Phase 1 program did record the sex of mummichog prior to compositing. Mummichog sex can be determined with some certainty based on external morphology, and so was done so in the field lab. White perch sex can only be determined with dissection and histological examination. This was not performed.

White perch size was recorded in Phase 1 and is planned to be recorded in all Phase 2 sampling events. The SOPs/FSPs include specific requirements to ensure that fish included in the samples are comparable in size.

All fish that have been and will be collected are in the range of the size of fish that could be ingested by receptors at the site. Data collected during the Phase 1 investigation demonstrated that the fish community in BCSA is dominated by mummichog and white perch. Both mummichog and white perch are potential prey for avian piscivores (which are a target receptor group in the BCSA), and the fish collected during Phase 1 were within the size range of the prey typically ingested by these receptors. Additionally, human anglers could catch and consume white perch. Overall, the Phase 1 white perch in the BCSA were in the range of 5 to 7 inches. Though these are probably smaller than the target size for an angler, they do represent the upper end of the predominant size range that is present in the BCSA, and that is available to anglers.

30. p. 3-34, Section 3.5 Task 5, Biota Investigation and Human Activity Assessment: The current plan to use benthic community will likely have limited utility given the difficulty in doing these studies well. Toxicity testing should be conducted during the RI/FS (Ph3?) to link effects with contaminants and assess effects to benthic organisms.

Response: As discussed during the February 2 and 3, 2010 meeting, the Group has evaluated the many factors that will likely influence COPC effects on benthic organisms in the BCSA. Based on this evaluation, the Group has recognized that little is known about the benthic community in the BCSA waterways. The New Jersey Meadowlands Environmental Research Institute (MERI) collected a small number of samples in Berry's Creek Canal as part of a larger study of the Meadowlands (Bragin *et al*, 2009), and a limited study was completed in Oritani Marsh, which included a few samples in Berry's Creek Canal (Barrett & Mcbrien, 2007). In addition, benthic invertebrate community characterization was completed in Eight Day Swamp, with limited sample collection in Peach Island Creek and Berry's Creek (Weis and Weis, 2003). No studies have been completed in LBC or MBC, where there is a significant range of salinity and other parameters that influence benthic community composition. Consequently, the Group has proposed to implement the benthic community survey across the BCSA study segments and the most representative reference area with regard to salinity and substrate composition, to understand community composition and variability before considering a toxicity testing proposal that is appropriate for BCSA conditions.

REFERENCES:

Bragin, B.A., Woolcott, C.A., Misuik, J. 2009. A Study of the Benthic Macroinvertebrate Community of an Urban Estuary: New Jersey's Hackensack Meadowlands. New Jersey Meadowlands Commission, December 2009.

Barrett, K.R., Mcbrien, M.A.. 2007. Chemical and biological assessment of an urban, estuarine marsh in northeastern New Jersey, USA. *Environmental Monitoring and Assessment* 123: 63-88.

Weis, P. and Weis, J.S. 2003. Eight Day Swamp: Assessment of Heavy Metal Contamination and Benthic Biodiversity. Final Report to the Meadowlands Environmental Research Institute, Project 2000-006, May 23, 2003.

31. Page 3-34, Task 5A, COPC Residues in the BCSA Food Web: The work plan notes, "Additionally, data for mummichog and fiddler crab will support an evaluation of the quantitative relationship between measured sediment concentrations and biological tissue, given that both of these species exhibit a relatively high degree of spatial fidelity and therefore may be more reliably paired with sediment data to examine bioaccumulation relationships." Please provide supporting studies that show a relationship between sediment concentrations and mercury concentration in these biota.

Response: The Group recognizes that the relationship between sediment concentrations of mercury and biota concentrations can be difficult to illustrate. However, additional data collected from a different year and season is needed to further examine the relationship in the BCSA. The results from Phase 1 and Phase 2 work will be presented in relation to the literature in the Phase 2 report.

32. <u>p. 3-34, Section 3.5.1 (Task 5A), General Comment</u>: Since tissue composites will be processed at an off-site laboratory, sufficient tissue mass must be shipped to support the proposed analysis. For whole-body samples, individual fish and crabs can be weighed. However, for the white perch fillet, blue crab muscle, and hepatopancreas samples, weights must be estimated. A detailed plan should be provided for processing the tissue samples. For example, will fillet weight be estimated off total body weight? And, will blue crab tissue be estimated from the carapace width? How will adequate *hepatopancreas composites be estimate? Moreover, a hierarchy of analyses needs to be proposed as a contingency plan in case the actual composite mass is less than the estimate composite mass.*

Response: White perch fillet weight will be estimated from total body weight. Detailed information collected during Phase 1 is available to accurately correlate fillet weight obtainable by the lab based on the total body weight measured in the field. Similarly, blue crab muscle tissue will be estimated from total body weight. Blue crab samples weights and their corresponding muscle tissue mass removed at the laboratory from samples collected during the Phase 1 investigation will be used to estimate the muscle tissue mass obtainable at the laboratory. This information is not available for blue crab hepatopancreas, as it was not analyzed during the Phase 1 investigation. However, the same method of estimating will be used. As soon as samples are available to send to the laboratory, they will be resected and the hepatopancreas weights determined. In addition, the literature will be consulted to determine if any existing information correlating blue crab size and/or weight to hepatopancreas weight is available.

As described in Section 6.1 of the FSP (QAPP, Appendix B), approximately 150 g fish tissue and 100 g edible crab tissue per sample will be collected for COPC analysis. Where possible, an excess mass of tissue will be submitted to the laboratory to ensure that adequate mass is available for analysis. In cases where inadequate mass is available, as during the Phase 1 investigation, the following hierarchy will be used to determine the order in which analyses are to be performed:

Metals
Methyl mercury and mercury
PCBs
Lipids
PAHs
Moisture

The analytical laboratory has a detailed SOP describing the tissue processing procedures. This SOP is provided in the QAPP.

33. <u>Section 3.5.1, Page 3-35 and Page 3-36 (Task 5A "White Perch")</u>: When practical, individual white perch fish should be analyzed instead of compositing several smaller fish to reach target mass.

Response: The Group proposes to continue using composite tissue analysis in Phase 2 for several reasons:

- Individual samples greatly reduce the number of fish that are effectively sampled (a single fish vs. the 4-8 fish per composite that are currently proposed), thereby increasing the chance of having a less representative data set.

- Individual samples will likely greatly increase sample variability. Composite samples help to limit this variability without analyzing a large number of fish. Lower variability will facilitate more definitive interpretation of the results and comparison to reference sites.
- Additionally, switching to individual fish affects the ability to compare across Phase 1 and Phase 2 datasets.

34. <u>Section 3.5.1, Page 3-36 (Task 5A "White Perch")</u>: The Ph2 Work Plan states that "If insufficient numbers of fish are caught to support whole-body and fillet analysis, fillet analysis will be prioritized to support the human health risk assessment." The ecological risk assessment should not be ignored. If an insufficient number of fish are caught, then the lab should analyze a fillet composite and a carcass composite. The whole-body sample can then be reconstituted.

Response: We do not anticipate this to be an issue. During Phase 1, we collected more than sufficient numbers of white perch to support whole body and fillet analysis. Should that not be the case, the ecological risk assessment will have whole body data from mummichogs.

35. <u>Section 3.5.1, Page 3-36 (Task 5A "Blue Crab")</u>: A definition of edible muscle needs to be provided. To support the ecological risk assessment, crabs selected for muscle-only compositing should also be processed for a carcass composite. The whole-body sample can then be reconstituted. Consequently, two tissue samples will be generated for 24 blue crab composites.

Response: A definition for edible muscle will be provided in the QAPP Addendum. With regard to the carcass analysis, the Group agrees to analyze the carcass as well as the edible muscle due to a more likely difference in edible muscle and total crab concentrations.

36. Page 3-35, first paragraph: Why will the smaller waterways only be sampled for mummichog? While white perch are unlikely to be found in these waterways, fiddler and blue crabs are expected.

Response: Based on the numerous hours in the field in 2009, the smaller waterways were nearly dry during most low tide periods and white perch and crab were not observed in these waterways during low tide and rarely observed during higher tides. Even mummichogs were difficult to collect in the smaller waterways. Consequently, white perch and crab were not included in the smaller tributaries because their occurrence is more transient and there is a low probability of

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obtaining an adequate sample.

37. p. 3-35 – 3-37. Fewer specimens should be used in the composites than were used in Phase 1. Samples that vary in size should not be composited.

Response: See response to comment #29.

38. Page 3-37, Section 3.5.2: The utility in continuing the human use surveys is not clear. The surveys in Phase 1 aided our understanding of human use in the area and we were able to select exposure factors accordingly. Further information will not result in further revision to these values.

Response: The camera surveys of human use will be continued at three locations, Paterson Plank Road, Route 3 Bridge and Berry's Creek Canal. The objective is to ensure a robust data set, as well as data from additional seasons to reduce uncertainty in the frequency and duration of human activity.

39. p. 3-39, 3.5.3 Task 5C – Fish Community Survey (RI-P2-T5C): The work plan states that fish community will be studied for comparison with reference sites. At the February meeting it was recommended to not pursue this line of study in the risk assessment since mercury studies have found confounding effects for this endpoint. The BERA work plan (Appendix N p. 2-11) states the following about the fish community, "Variability in abundance and community composition of species across reaches and throughout the seasons was likely due to a number of environmental factors including salinity, dissolved oxygen, temperature, prey availability and physical habitat as well as life history characteristics." References should be provided that demonstrate statistically measurable differences in fish communities due to Hg and PCB sediment contamination in tidal marsh habitats. If studies showing a relationship are available, it would be helpful to have an explanation on how the studies were done, what was analyzed, how it was analyzed (statistics) and how it was demonstrated that fish communities inhabiting areas contaminated by Hg and PCBs were statistically altered by different sediment contaminant concentrations in these types of habitats. Weis and her students found that mummichog were smaller and had less food in their stomachs at a Hg-contaminated site compared to an uncontaminated site. Looking at numbers of fish was not useful as some predators were more affected by contamination than others so some species had higher abundance in the contaminated areas when their predator species was affected. Understanding community relationships is very difficult and likely very expensive. Weis has supported numerous graduate students over many years to understand the community changes from Hg, and is still learning how complex the relationships are.

Response: Monitoring aquatic community responses to stressors has long been an established method of ecological assessment (Barbour et al. 1999 and references therein). In the BCSA, the COPCs are not limited to PCBs and mercury but also include other metals. In addition, ecological risk assessment guidance (USEPA 1997) recognizes the value of collecting information directly from multiple levels of the biological hierarchy, not just the population level. In addition, there are population level endpoints included in the ecological risk assessment and the results of those studies will be evaluated in relation to the community as well as the individual species population. Therefore, community data, although often difficult to interpret from a cause and effect relationship, is needed to provide context for population level findings, as well as evaluate if effects not evident at the population level may be observed at the community level.

With regard to the fish community in particular, fish tissue will be a component of the future Remedial Action Objectives (RAOs). Therefore, understanding the BCSA fish community in relation to the reference areas as part of the baseline studies is valuable in establishing the overall health of the fish community in the BCSA and its use as a cleanup metric and in the evaluation of short term and long term impacts in the risk analysis.

REFERENCES SUPPORTING COMMENT RESPONSE:
Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency: Office of Water; Washington, D.C. 340 pp.

USEPA. 1997. Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. EPA 540-R-97-006. U.S. Environmental Protection Agency: Solid Waste and Emergency Response; Washington, D.C. 226 pp.

40. Section 3.5.4, Page 3-42: Hg and PCB concentrations in stomach contents of white perch (or other larger, higher-trophic level fish, such as striped bass) should be measured.

Response: Based on the findings of the Phase 1 fish community study, striped bass are very infrequent in the BCSA and therefore, are not a good target sampling species. The Group proposes to collect stomach contents of white perch in Phase 2 to identify the principal prey of this species in the BCSA. This is being done to support a better understanding of the BCSA food web and COPC bioaccumulation dynamics. Inclusion of COPC analysis in this effort would substantially increase the required number of fish guts that need to be collected so that analytical mass requirements can be met for each prey item, and therefore is a substantial field addition. Regardless, the Group believes that COPC analysis of stomach content is not needed or warranted to support the Phase 2 RI. Direct measurement of COPC residues in the fish will provide an indication of the degree to which COPCs are accumulating from prey. Information on the composition of white perch prey will aid in the understanding of the food web contributing to accumulated residues and help identify the important prey species. If a decision is made that information is needed on the COPC residues in important prey species, the appropriate study can be conducted in Phase 3.

41. Section 3.5.5, Page 3-45 (Task 5E), First Sentence: The baseline ecological risk assessment (BERA) needs to include a benthic organism.

Response: Tissue data are being collected from fiddler crabs and blue crabs. In addition, the benthic community surveys in Phase 2 will be used, in part, to determine if another benthic organism should be included in the BERA.

42. Section 3.5.5, Page 3-45 (Task 5E): The benthic community survey should include a triad sampling approach, which consists of a benthic community survey, sediment chemistry, and toxicity testing for each sampling location.

Response: The use of the triad approach to sediment evaluation will be assessed following Phase 2, taking into account the benthic community survey results and the factors that would influence the use of toxicity testing (e.g., salinity patterns, dissolved oxygen patterns, substrate composition).

43. Section 3.5.5, Page 3-45 (Task 5E): The community survey should be conducted in replicate to assess diversity. Consequently, 3 samples per location should be submitted for taxonomic classification.

Response: The benthic community survey will be revised in the Work Plan Addendum to include:

A. Six samples per study segment for taxonomic classification.
B. Two samples will be paired at five separate locations in each segment. One sample will be collected from approximately midway up the mudflat at low tide and the other near the thalweg in the adjacent subtidal area.
C. Similar sampling will be completed at five locations in the Bellman's Creek reference area where salinity matches the UBC, MBC and BCC/LBC study segments.

This will provide a stratified sampling approach in replicate that will support the objective of a benthic community survey for the design of subsequent studies.

44. p. 3-45: Benthic microalgae should be collected directly from the surfaces they colonize since this is what is eaten by the biota.

Response: The Phase 2 program calls for the placement of sampling tiles on the marsh surface to collect benthic microalgae. Because natural substrates can vary in size, texture, and origin, investigators searching for microalgal colonization often use artificial substrata to reduce this variability (Hauer and Lamberti 2006). Clay tiles have been shown in the literature to provide more reproducible results than other artificial substrates including sterilized rocks (Tuchman and Stevenson 1980, Lamberti and Resh 1985). Further, clay tiles are widely used in various aquatic habitats to assess microalgal colonization in the field (e.g., Becker et al. 1997, Peterson et al. 1990).

The plates will be in place for 30 days and will simulate the feeding environment of the biota since non-algal particles will also settle on the tiles. Tiles can be retrieved onto the deck of the boat and scraped into sample collection jars. Collection directly from the marsh surface would be logistically challenging and time intensive: it can only be performed at low tide, and would require a separate sampling effort. In the current plan, the tiles will be collected and scraped during incoming and outgoing tide while trawling for phytoplankton

REFERENCES SUPPORTING COMMENT RESPONSE:

Becker, G., H. Holfeld, A.T. Hasselrot, D.M. Fiebig, and D.A. Menzler. 1997. Use of a microscope photometer to analyze in vivo fluorescence intensity of epilithic microalgae grown on artificial substrata. *Applied Environ. Microbiol.* 63:1318-1325.

Hauer, F.R., and G.A. Lamberti (eds). 2006. *Methods in stream ecology, 2nd ed.* Academic Press, Inc., Burlington, MA. 896 pp.

Lamberti, G.A., and V.H. Resh. 1985. Comparability of introduced tiles and natural substrates for sampling lotic bacteria, algae and macroinvertebrates. *Fresh. Biol.* 15:21-30.

Palmer, E.L., and H.S. Fowler. 1975. Fieldbook of Natural History, Second Edition. McGraw-Hill Book Company, New York, NY. 779 pp.

Peterson, C.G., K.D. Hoagland, and R.J. Stevenson. 1990. Timing of wave disturbance and the resistance and recovery of a freshwater epilithic microalgal community. *J. N. Amer. Benthol. Soc.* 9:54-67.

Tuchman, M.L., and R.J. Stevenson. 1980. Comparison of clay tile, sterilized rock, and natural substrate diatom communities in a small stream in southeastern Michigan, USA. *Hydrobiologia* 75:73-79.

45. p. 3-46, Section 3.5.6 Task 5F, Qualitative Survey of Invertebrate/Insect Community: Total Hg concentrations should be measured in insects during this phase since they will be collected.

Response: To be meaningful in the ecological risk assessment, any measurements of mercury in the insects should be limited to the types of insects that are known to be prey of the measurement endpoint. Designing such a study first requires some field verification of insects present at the site and their variability over a couple of seasons (summer and early fall of this year) consistent with ecological risk assessment guidance. Therefore, the qualitative step will be completed first, along with the next stage of the risk assessment before determining what additional tissue samples may be needed to support the risk characterization.

46. p. 3-46: Songbirds were selected over raptors because of narrower foraging range; but which is most susceptible to effects and which is most likely to have literature data? The songbird diet does not preferentially include aquatic species.

Response: Songbirds were selected as a receptor in the marsh where a mixture of terrestrial and aquatic invertebrate prey predominates. Literature shows that marsh songbirds will consume both aquatic and terrestrial invertebrates (Palmer and Fowler 1975). Wading birds were selected as the receptor for the waterway environment, and will consume a diet consisting largely of fish and aquatic invertebrates. The Group finds that the selected avian receptors are those species likely to be the most highly exposed.

47. p. 3-50: The Mill Creek Reference area contains two mitigation projects and is not appropriate for wetland function comparisons. Please provide examples of studies that demonstrate the ability to measure statistically significant wetland functional changes as a result of Hg and PCB contamination to best understand what parameters to measure, etc.

Response: Mill Creek has sections of it that were not modified as part of the mitigation projects. In addition, wetlands functions and values from that system are anticipated to be of value during the FS when evaluating restoration objectives for wetland areas that may be impacted by remedial actions. Wetland functions are widely used for comparative analysis of different wetland areas and for pre- and post disturbance analysis (References below).

REFERENCES SUPPORTING COMMENT RESPONSE:

Bartoldus, C.C. 1999. A Comprehensive Review of Wetland Assessment Procedures: A Guide for Wetland Practitioners. Environmental Concern, Inc., St. Michaels, MD.

Bartoldus, C.C., Garbisch, E.W., and Kraus, M.L. 1994. Evaluation for Planned Wetlands: A Procedure for Assessing Wetland Functions and a Guide to Functional Design. Environmental Concern, Inc., St. Michaels, MD.

The Louis Berger Group, Inc. 2004. Regional Guidebook for Hydrogeomorphic Assessment of Tidal Fringe Wetlands in the Hackensack Meadowlands. Prepared for the New Jersey Meadowlands Commission, January, 2004.

Smith, R. D., Ammann, A., Bartoldus, C., and Brinson, M. M. 1995. An Approach for Assessing Wetland Functions using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices," Technical Report WRP-DE-9, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

48. p. 3-52: 3.6.1 Task 6A, Biota Sampling: Measured Hg and PCB tissue residues (and other bioaccumulative contaminants) should be compared in BCSA biota and other areas to effects thresholds in the literature as a line of evidence. Fish sampling for COPC analysis should be designed with seasonality in mind. Weis et al, 1986 found that monitoring of mercury levels of fish collected from Berry's Creek throughout the year revealed a 5-fold increase during the summer months.

Response: The literature-based effects thresholds will be used as one line of evidence in the risk assessment. There are, however, important uncertainties associated with these values and this uncertainty will be noted in the risk assessment. Fish tissue sample collection is proposed in the summer, to evaluate the anticipated higher fish tissue concentrations as described in Weis et al. (1986) and Weis and Ashley (2007).

REFERENCE:
Weis, P. and Ashley, J.T.F. 2007. Contaminants in fish of the Hackensack Meadowlands, New Jersey: Size, sex, and seasonal relationships as related to health risks. *Archives of Environmental Contamination and Toxicology* 52: 80-89.

49. p. 3-63: The biological uptake model requires information on percent of total food ingested and site use; both of these are unknowns. If they are used then an upper bound estimate for chemical concentrations should be used.

Response: Site-specific data and literature will be used to develop realistic estimates of percent of total food ingested and site use.

50. p. 4-1, Section 4, Ecological Risk Assessment Approach: For Risk Characterization it is unclear how the types of studies planned will be able to be tied to specific contaminants of concern or mixtures.

Response: Measurement endpoint data will be evaluated in the context of COPC concentration data, consistent with USEPA risk assessment guidance. Any observed changes in measurement endpoints will be analyzed in relation to gradients of conditions (CERCLA-stressors-COPCs, conventional parameters-DO, salinity, etc.). In addition, the data will be compared to concentrations and responses at reference sites, taking into account known mechanisms of toxicity and information that indicates the relative bioavailability of COPCs.

51. p. 4-3, Risk Characterization: Were species of special concern identified?

Response: Yes, for example the Least Bittern. The species of special concern will be described in subsequent ecological risk assessment deliverables.

52. Page 5-1, Section 5.1: Please add RAGS F (2009) to the list of USEPA guidance documents.

Response: Agreed. In addition, the COPCs include other chemicals beside mercury and PCB. Also, the Group will continue to evaluate parameters in addition to the COPCs.

53. Page 5-2, Section 5.3.2: The Draft BHHRA should include RAGS D Tables 1-10.

Response: Agreed.

54. Tables 3-3 through 3-8 include Phase 2 proposed tasks/investigations. Several of these tasks involve community survey type investigations. Further details should be included regarding how the data from these surveys will support the determination of remediation goals.

Response: See response to comment #39. Additional details are being added to the Phase 2 Work Plan Addendum.

55. Table 3-8, Task 6B: It is suggested that additional sediment samples be collected from each of the reference areas as sediment data are highly variable. Ensure enough samples are collected, especially in the sediments, to perform the necessary statistics.

Response: The Group reviewed the number of sediment samples and agrees that an increase in the number of reference areas samples is warranted. Additional samples will be collected from reference areas to address the specific study questions as the RI progresses. For example, the number of marsh sediment samples in the reference areas has been increased from 18 to 42 total.

56. Table 3-8, Task 6C: It is suggested that additional Phragmites samples be collected from each of the reference areas as one sample would not be statistically significant for a comparison with Phragmites in the BCSA.

Response: The number of *Phragmites* samples was increased to three per reference area.

References:

Environmental Protection Agency. 2000. Guidance for Assessing Chemical Contaminant Data in Fish Advisories, Vol. 1, Fish Sampling and Analysis, Third Edition. EPA-823-B-00-007. Office of Water. Washington, DC.

ATTACHMENT 2
LETTER TO DOUG TOMCHUK; JULY 27, 2010
PHASE 2 QUALITY ASSURANCE PROTECTION PLAN/FIELD SAMPLING PLAN - RESPONSE TO COMMENTS (RTC)

General Comments

1. *QAPP/FSP Worksheet #6, Communication Pathways – Since Phase 2 employs new laboratories for some of the analyses being performed, this worksheet needs to be updated. In addition, there appears to be a change in the contact person for Test America that will potentially affect the communication pathway for that particular laboratory.*

Response: Worksheet #6 will be updated as requested.

2. *QAPP/FSP Worksheet #12, Measurement Performance Criteria Table – The worksheets were not clear if the field duplicate measurement performance criteria that applies for the solid sample matrix also applies to the phragmites matrix. In addition, please complete the measurement performance criteria information for stable isotope analysis in tissue and phragmites and geotechnical analysis for the sediment when the laboratory selections have been made. In addition, the corresponding laboratory SOPs should also be provided.*

Response: Worksheet #12 will be expanded to include relevant measurement performance criteria (MPC) for the *Phragmites* matrix. Worksheet #12 will also be updated to provide the requested relevant information for isotope and geotechnical analyses, and the associated laboratory SOPs will be included. Note that MPC for geotechnical and stable isotope analyses are more limited and different than those of routine COPC analyses. For example, stable isotope analytical methods do not include a reporting limit; they report a fraction of isotopes.

3. *Worksheets 12 and 28, General Comment: Several inconsistencies exist between Worksheet 12 and Worksheet 28. For example, on page 374 (Worksheet 28), cation exchange capacity analyses have only one quality control (QC) sample parameter: method blank. However, in the Worksheet 12, cation exchange capacity has more QC sample parameters. Revise accordingly.*

Response: Worksheet #12 identifies the data quality indicators (DQIs) and MPC for each matrix, analytical group, and concentration level. Worksheet #28 presents the minimum laboratory quality control samples required for each analytical method, matrix and concentration level that are required to support the DQIs for the project. These include laboratory control samples, matrix spikes, laboratory duplicates, etc., but do not include calibration MPC or field QC samples for measuring DQIs. Therefore, the laboratory QC samples listed in Worksheet #12 have been reviewed to determine consistency with Worksheet #28 and corrections have been made, if required.

4. *Worksheets 12 and 20, General Comment: Several inconsistencies exist between Worksheet 12 and Worksheet 20. For example, on Worksheet 20, methylmercury does not require a matrix spike/matrix spike duplicate (MS/MSD), but in the Worksheet 12, methylmercury does have a MS/MSD requirement. Revise accordingly.*

Response: Worksheets 12 and 20 will be reconciled as requested.

5. *Worksheet 12, General Comment: Data completeness QC is needed for all analytical groups.*

Response: Worksheet 12 will be expanded to provide data completeness QC as requested.

6. *Worksheet 12, General Comment: Model number and manufacturer of proposed performance testing (PT) samples should be listed in Worksheet 12 or provided as an appendix.*

Response: In accordance with the Statement of Work (SOW) for the RI/FS, PT samples were submitted to the analytical laboratories in advance of Phase 1 characterization activities. Hence, PT samples will not be submitted for Phase 2, except for radionuclide analysis. No standardized performance testing protocols exist for geotechnical or stable isotope analysis.

7. *Worksheet 12, General Comment: The referenced page numbers on the cover page of Worksheet 12 are incorrect. Revise accordingly.*

Response: The page number references will be corrected as requested.

8. *Worksheet 12, General Comment: The cover page for Worksheet 12 has multiple listing of parameters. For example, phragmites methylmercury analysis is listed as occurring at Test American North Canton and Brooks Rand. It appears based on Worksheet 30 that both the proposed and back-up laboratories are listed on Worksheet 12. These multiple listings are confusing. Worksheet 12 should provide the measurement performance criteria for the proposed laboratory. The back-up laboratory must meet or exceed these criteria. Remove listings and criteria for back-up laboratory from Worksheet 12.*

Response: The unnecessary information will be removed from Worksheet 12 as requested.

9. *Worksheet 12 and Worksheet 20: PT samples listed in Worksheet 12 need to be listed in Worksheet 20. Revise accordingly.*

Response: Please see the response to Comment #6.

10. Worksheet 12, Page 39 "PCB": The comments on the Phase 2 Work Plan Addendum asked for additional justification as to why the BCSA Group supported the used of Aroclor PCB analysis rather than congener PCB analysis. Based on the resolution of this issue, the QAPP may need to include the analysis of PCB congeners.

Response: Please see the response to Phase 2 Work Plan Specific Comment #2.

11. Worksheet 12, Page 47 "TCLP": TCLP analysis as listed in Worksheet 12. However, the rationale for TCLP analysis was not provided in the Work Plan. Please include.

Response: TCLP is one of several parameters undergoing testing to support Feasibility Study (FS) activities and the rationale for the testing has been added to the Work Plan Addendum. TCLP analyses will be used in two general areas: (i) testing of settled solids in column settling tests, and (ii) testing of sediment for direct disposal requirements.

12. Worksheet 12, Page 51 "VOC": Continuing calibration verification has no data quality indicator.

Response: The DQI will be filled in as "Accuracy."

13. Worksheet 12, Page 61 "PCB (Surface water)": Since PCB compounds have a high affinity for the particulate phase, analysis of PCB compounds in surface water should include direct measurements of the PCB particulate-phase. Particulate-phase PCB cannot be calculated by subtracting the dissolved-phase (filtered) concentration from a whole water sample. Revise accordingly.

Response: Please see the response to Phase 2 Work Plan Addendum Comment #13. It is not necessary to measure the concentration of COPCs on particulates *per se*; analyzing total (unfiltered) aliquots of surface water is sufficient to characterize the bulk presence and transport of PCBs in surface water.

14. Worksheet 12, Page 83 "Sulfides":_The rationale for analyzing phragmites tissue material for total sulfides is unclear.

Response: Upon further review, analyzing *Phragmites* tissue for sulfides is unnecessary. The reference will be removed.

15. Worksheet 12, Page 96 "Radioloigcal": The "data quality indicator" and "QC sample access error for sampling or analytical" should be provided for matrix spike.

Response: Worksheet #12 will be expanded to include DQIs and assessment information for MS/MSDs for radiological analyses.

16. Worksheet 12, Page 96 "Radiological": All radiological samples from the surface sediment should be analyzed for Be-7.

Response: The need for and approach to additional Be-7 samples will be evaluated in more detail as part of the review of the resuspension of sediments (see response to Work Plan Specific Comment #1).

17. Worksheet 12, Page 108 "Mercury": The "data quality indicator," "QC sample access error," and "measurement performance criterion" are needed for calibration blank.

Response: The requested information will be added to Worksheet 12.

18. Worksheet 12, Page 114, "Stable Isotopes": The measurement performance criteria table is needed for stable isotopes from Isotech Laboratories, Inc. Please complete this worksheet.

Response: The requested information will be added to Worksheet 12. As noted in the Response to Comment #2, it is expected that limited criteria are available for stable isotope analyses compared to conventional COPC analyses. Relevant information will be added as available.

19. QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 140 of 496 – Since a number of the action limits for the pesticides in surface water (marine and fresh water) are considerably lower than the project quantitation limits using SW-8081, have the laboratory been consulted if the appropriate limits can be achieved with this method?

Response: In Phase 1, the laboratory analyzed the surface water samples for pesticide analysis with no dilution to achieve the lowest quantitation limit possible. However, matrix interferences (i.e., salinity, TDS) in some samples affected the continuing calibration verification (CCV) at the low end of the calibration range, thereby increasing the reporting limit. While an additional low concentration standard could possibly be incorporated to try to achieve greater precision in the low concentration range, matrix issues would likely continue to be an issue in many samples. Dilution of samples may alleviate some matrix issues, but would also negatively affect reporting limits, so dilution is not recommended.

Based on discussions with the laboratory, a high resolution method for pesticides is available (reporting limit = 0.4 mg/L), but is not recommended for the BCSA for several reasons. The primary concern with applying the high resolution method for BCSA surface water samples is matrix interference due to salinity. The laboratory has implemented this method in brackish settings previously but matrix interference caused an order of magnitude increase in the reporting limit, effectively eliminating the benefits of using the alternate method. In addition, the high resolution method still would not achieve all of the pesticide screening values, even under ideal conditions. Also, the cost associated with the high resolution method is approximately 10 times the cost of the analytical method used in Phase 1 and proposed for Phase 2.

Pesticides in surface water were of relatively minor importance during Phase 1 risk screening. Only one pesticide, 4,4'-DDE, was observed in BCSA surface water in concentrations that exceeded benchmark values and associated Reference Sites concentrations. This one parameter, 4,4'-DDE, was not found to be a risk driver in sediment or biota. It is understood that the relative lack of exceedances for pesticides in surface water may simply be due to elevated reporting limits. However, the very low screening values for surface water pesticides to which the comment refers are generally derived based on human health exposures via aquatic organisms. Instead of relying upon these conservative screening values based upon assumed biomagnification factors, we can more rigorously and directly evaluate this pathway through a review of pesticide data in biota. The Phase 1 dataset for pesticides in biota showed that only one pesticide, endrin ketone, exceeded risk screening levels in fish tissue; concentrations for this parameter did not exceed corresponding screening levels in sediments or surface water. Overall, in consideration of pesticide data across several media, it appears that the current analytical sensitivity for pesticides in surface water is sufficient to characterize likely risk pathways for pesticides in surface water. In summary, the available high resolution method is unlikely to provide significantly lower reporting limits due to matrix interferences inherent to BCSA samples, and will provide little to no additional value in quantifying the site-specific risks or in reducing the uncertainty. No change of pesticide analytical method is proposed for Phase 2.

20. QAPP/FSP Worksheets #15, Reference Limits and Evaluation Table, pages 149 to 154 of 496 – The SVOCs list included several analytes that have lower action limits than the project quantitation limits. It appears that a more sensitive method should have been considered, as was indicated in footnote #1 on page 133. The comment also applies to the PCB analysis and PAH analysis.

Response: Several dozen SVOCs, including PAHs, were observed in BCSA sediments at levels that exceeded sediment benchmarks. However, in virtually all cases, levels were no greater than those of associated Reference Sites samples. The two parameters (benzo(k)fluoranthene and dimethyl phthalate) with concentrations in sediment that were statistically significantly higher than those of the Reference Sites were not observed exceeding screening values in surface water or tissue. As a result, SVOCs are not predicted to contribute to the site-specific risks. The numerous SVOC detections in the Phase 1 program showed sufficient sensitivity to adequately characterize these parameters. Increasing surface water analytical sensitivity would hence add little value and would moreover present considerable challenges, as several suites of Selective Ion Monitoring (SIM) would be required.

PCB detection frequencies in Phase 1 surface water datasets varied among sampling quarters; however, the analytical sensitivity was sufficient to provide insights concerning areas of elevated PCB presence and the effects of changing weather conditions. Additionally, PCB analytical sensitivity in sediment and biota was clearly adequate, as PCBs were detected in 118 out of 121 Biologically Active Zone (BAZ) samples and all biota samples in Phase 1. Hence, overall, the analytical program appears to be well suited to characterize PCB presence and transport mechanisms in the BCSA.

21. QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 176 of 496 –The arsenic achievable laboratory limit using SW-6010B for sediment is higher that the project action limits in both freshwater and marine environment. A more sensitive analytical method should be considered.

Response: In Phase 1, arsenic was detected in all 121 General BAZ sediment samples. Hence, it is not necessary to increase the analytical sensitivity for arsenic.

22. QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 188 of 496 – The project quantitation limits and laboratory achievable limits from Eberline should be provided for Cs137 and Pb210.

Response: The requested information will be provided in Worksheet 15.

23. QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 189 of 496 – The arsenic quantitation limit is higher than the project action limit for the surface water samples. A more sensitive method should be considered.

Response: In Phase 1, 274 filtered and unfiltered manual samples were collected through three sampling quarters and one manual storm sampling event. More than two-thirds of the samples showed detections for arsenic. Yet, no surface water samples exceeded the screening benchmark for arsenic. This indicates that the Phase 1 analytical program adequately characterized the prevalence of arsenic in surface water while showing that it is not an important parameter from the standpoint of risk characterization. Hence, more sensitive analyses are not warranted.

24. QAPP/FSP Worksheet #15, Reference Limits and Evaluation Table, page 197 and page 202 of 496 – The worksheets corresponding to Brooks Rand and Test America, North Canton have different methyl mercury project action limits. Please reconcile.

Response: No samples are proposed for analysis at Brooks Rand during Phase 2, so their information is no longer reflected in the document. The information for Test America-North Canton will apply.

25. Worksheet #15 for the stable isotope analysis was not included in the QAPP. Please provide this information when information from the laboratory becomes available.

Response: The requested relevant information will be provided in Worksheet #15.

26. QAPP/FSP Worksheet #19, Analytical SOP Requirements, page 251 of 496 – Please clarify if the two sets of sediment samples for VOA analysis are being preserved with both methanol and water, i.e., 3 vials with methanol preservatives and another 3 vials with water.

Response: Three vials will be used in all. One vial will contain methanol as a preservative, whereas the second and third vials will contain water.

27. QAPP/FSP Worksheet #23, Analytical SOP References – The "to be determined" SOPs should be provided once it is made available by the laboratories.

Response: The requested SOPs will be provided in the revised Appendix D if the associated laboratories are able to provide same. In cases in which full SOPs are not available due to concerns stemming from proprietary information, analytical summary sheets will be provided.

28. QAPP/Worksheet #28, Laboratory QC Samples – The information for samples that will be sent to Eberline Services and Isotech Laboratories should be completed.

Response: The requested applicable laboratory QC information will be added to Worksheet #28.

29. FSP Section 2.1.2 Station Description and Installation, page 2-2 – For consistency with the information provided in the section regarding the moored hydrodynamic/water quality monitoring stations, the last paragraph describing the *use of the WET Labs ECO Fluorometers (FLSBs) should be also include a reference to it's operation and maintenance procedures.*

Response: The FSP will be updated to include a reference to Worksheet #22, where the information is provided.

30. *SOP 1.3 Dye Tracer Study Section 2.1 Injection and Sampling Procedures, page 3 of 5 – The model number for the fluorolog spectrofluorometer provided in the last paragraph of this section did not match the model number provided in the specifications as outlined in Table 2.*

Response: The instrument model number will be reconciled between the text and table in SOP 1.3.

31. *Worksheet 15, Page 139 "Metals": A CAS number is needed for cadmium.*

Response: The requested CAS number, 7440-43-9, will be added to the table.

32. *Worksheet 15, Page 143 "Metals": A CAS number is needed for aluminum.*

Response: The requested CAS number, 7429-90-5, will be added to the table.

33. *Worksheet 15, Page 182 "Total Suspended Solids": The analytical method for total suspended solids is EPA 160.2/SM2540B, not EPA 160.1/SM2540D. Method EPA 160.1 is for total dissolved solids.*

Response: The reference will be corrected as requested.

34. *Worksheet 19, General Comment: State whether sample volumes represent the maximum or minimum mass required per analysis. More importantly, a footnote must be provided stating the minimum tissue mass and how the white perch fillet and blue crab tissue samples will be estimated. Since tissue composites will be processed at an off-site laboratory, sufficient tissue mass must be shipped to support the proposed analysis. For whole-body samples, individual fish and crabs can be weighed. However, for the white perch fillet, blue crab muscle, and hepatopancreas samples, weights must be estimated. A detailed plan should be provided for processing the tissue samples.*

Response: A footnote has been added to Worksheet #19 indicating that the reported sample volumes are the actual sample amounts used for the analyses as required by the referenced SOP. Minimum sample amounts collected in the field exceed these values. Field methods for biota sampling, including the actual mass to be sampled, are provided in field SOP 5.1. SOP 5.1, the SOP for aquatic biota sampling, will be updated with an addendum table that lists the tissue mass that is necessary for shipment to the laboratory in cases in which the laboratory processes the tissue for analysis.

White perch filet weight will be estimated based off total body weight. Detailed information collected during P1 is available to accurately correlate filet weight obtainable by the lab based on the total body weight measured in the field. Similarly, blue crab muscle tissue will be estimated from total body weight. Blue crab samples weights and their corresponding muscle tissue mass removed at the laboratory from samples collected during the P1 investigation will be used to estimate the muscle tissue mass obtainable at the laboratory. This information is not available for blue crab hepatopancreas, as it was not analyzed during the P1 investigation. However, the same method of estimating will be used. As soon as samples are available to send to the laboratory, they will be resected and the hepatopancreas weights determined. In addition, the literature will be consulted to determine if any existing information correlating blue crab size and/or weight to hepatopancreas weight is available.

Where possible, an excess mass of tissue will be submitted to the laboratory to ensure that adequate mass is available for analysis.

35. Worksheet 19, Page 252, "Total Organic Carbon (TOC)": The sample volume of 50 milligrams (mg) for TOC will not represent the heterogeneity of the sediment samples. Approximately 5-10 grams of sediment needs be shipped to the laboratory for analysis.

Response: The 50 mg noted for TOC analysis only refers to the minimum mass necessary for adequate testing. We concur that it is better to sample from a larger aliquot to capture more broadly representative conditions. The sampling protocol does accomplish this. The sampling program includes several analytical suites that jointly require a much larger mass (more than 1 pound) to meet all of the analytical requirements. Excepting sensitive parameter suites, such as VOCs and AVS/SEM, aliquots for all analytical groups are drawn from one large, homogenized aliquot that weighs several pounds. Hence, the objective of the comment is met, in that the TOC analysis will represent the TOC of a sediment aliquot that is far greater than 50 mg.

A footnote has been added to Worksheet #19 indicating that the reported sample volumes are the actual sample amounts used for the analyses as required by the referenced SOP.

36. Worksheet 19, Page 253-254 and Worksheet 30, Page 489: Physical properties, such as shear stress/strength, bulk density, Atterberg Limit, and Permeability as listed in Worksheet 19. However, a rationale for these parameters was not provided in the

Work Plan. Justification for these analyses should be incorporated in the QAPP (e.g., Worksheets 12, 15, and 28).

Response: Justification for these parameters has been added to the Work Plan Addendum. Worksheets 12, 15 and 28 have been updated with required information for these analyses.

37. Worksheet 19, Page 259 "Biota": To assess benthic diversity, community survey must be conducted in replicate. Consequently, 3 samples per location must be submitted for taxonomic classification

Response: Three benthic community samples will be collected per study segment and generalized bedform, i.e., each study segment will have three benthic community analyses in the intertidal zone and three analyses in the subtidal zone.

38. Worksheet 19, Page 259 "Moisture Content": The analytical method of moisture content for tissue sample, SM2540G, does not match with Worksheet 12 and Worksheet 15.

Response: Worksheets 12, 15, and 19 will be corrected and reconciled as requested.

39. Worksheet 23, Page 321 "Tissue Handling Standard": The SOP listed in Worksheet 23 was provided by Test America Knoxville. However, phragmites tissue samples will be processed by Test America North Canton and Pittsburg. The proper handling of plant material is critical to minimize cross-contamination and blank contamination. An SOP for plant material handling and processing should be submitted for Test American North Canton and Pittsburgh. Moreover, if these phragmites data are intended to be handled as one dataset, then the two laboratories must handle the tissue with the same SOP.

Response: A plant processing SOP that will be uniform between the analytical laboratory locations will be provided in a revised Appendix D to the QAPP/FSP.

40. Worksheet 23, Page 326 "Test America North Canton": Test America North Canton must provide a SOP documenting their cleanup procedure for plant material. Matrix interference is very likely with plant material and must be minimized to avoid high detection limits.

Response: The requested SOP will be provided in a revised Appendix D. However, no cleanup procedure is necessary for the plant material.

41. Worksheet 28, Page 465: Be-7 is included in the radionuclide analytical group, but it is not included in the Worksheet 12 and Worksheet 15. Revise accordingly.

Response: The reference to ^{7}Be will be removed from Worksheet #28 as it is not currently proposed for Phase 2, but it can be added in the supplemental Phase 2 Work Plan Addendum if warranted after the August work session.

42. Appendix C Standard Operating Procedures – It appears that there are changes to some of the SOPs when compared to the 2009 SOPs. Since some of these SOPs refer to one another, it would be helpful if a version/revision numbering system is used to keep tracked of these SOPs and also would avoid potential confusion on the actual SOP that will be used. This would apply to SOPs 2.2 Manual Collection of Water Samples; SOP 3.2 Sediment Sampling and SOP 5.1 Aquatic Biota Survey.

Response: The table of contents will be modified to act as a revision tracking table as well. SOP headers will be updated to reflect the latest revision number.

43. QAPP Appendix E (Task 3D) and FSP Section 4.0: The Phase 2 program should report the concentration of polar lipid fatty acids in sediment to further characterize sediment microbial biomass composition, provide data for correlation with organic carbon data, and permit evaluation of contaminant biotransformation (e.g., methylation and metabolism) potential.

Response: The role of benthic microalgae will be assessed in Phase 2 through the proposed foodweb study. Additionally, several studies are planned to characterize the mechanisms that control methylation and demethylation, including (i) the high-resolution marsh cores, and (ii) the characterization of biologically degradable organic carbon (BDOC). Hence, characterization of polar lipid fatty acids in sediments is not necessary at present.

44. FSP Sections 6.0 and 7.0 (Tasks 5F and 6F): In comparing ecological data from Berry's Creek to reference areas, the BCSA Group should account for differences in habitat population survey statistics and bioaccumulation potential attributable to the relative abundance of invasive species (e.g., Asian shore crab, Hemigrapsus sanguineus) as that may operate as environmental stressors independent of contaminants. Refer to Reichmuth et al., "Differences in Prey Capture Behavior in Populations of Blue Crab in Contaminated and Clean Estuaries in New Jersey" in "Estuaries and Coasts" Vol. 32, No. 2, March, 2009.

Response: Upon the completion of fauna surveys in the BCSA and Reference Sites, field data will be reviewed to assess the role of invasive species in either the BCSA or Reference Sites.

ATTACHMENT 3
LETTER TO DOUG TOMCHUK; JULY 27, 2010
REQUESTED PARTIAL APPROVAL TASKS AND SUBTASKS

Task 2 – Surface Water Investigation
- A: Routine Monitoring (quarterly monitoring only)

Task 3 – Sediment Investigation
- B: Supplementary BAZ Sediment Sampling
- D: Marsh Sediment Sampling
- E: *Phragmites* Sampling

Task 4 – Ground Water/Surface Water Interflow
- A: Marsh Interflow Characterization
- B: Focused Study of Groundwater Discharge from Landfills

Task 5 – Biota Investigation and Human Activities
- A: COPC Residues in the BCSA Food Web
- B: Survey of Human Activity Patterns in the BCSA
- C: Fish Community Survey
- D: Food Web Study
- E: Benthic Survey
- F: Qualitative Survey of Marsh Invertebrate/Insect Community
- G: Evaluation of BCSA Marsh Production, Functions, and Values

Task 6 – Reference Site Evaluation
- A: Biota Sampling
- B: Marsh Sediment Sampling
- C: *Phragmites* Sampling
- D: Fish Community Survey
- E: Food Web Study
- F: Benthic Survey
- G: Survey of Marsh Invertebrate/Insect Community
- H: Evaluation of Reference Site Marsh Productions, Functions and Values

Task 9 – Data Management/Data Validation/Field Audits

elm

EPA Comments on the
Revised Phase 2 Work Plan Addendum
February 3, 2011

General Comments

1. Section 3, pp. 3-5 to 3-7: The Work Plan presents the basis to use PCB Aroclor analyses rather than PCB congener analyses. The current language goes much further than appropriate for a document seeking EPA approval. Up to this point in the study, EPA has allowed Aroclor analysis for the BCSA samples, along with evaluation of the congener specific PCB data collected for the Universal Oil Products (UOP) site. However, EPA cannot agree to the current language in the work plan that questions the validity of congener specific techniques, and which ignores the short-comings of PCB Aroclor analysis as well as the potential usefulness of PCB congener data. EPA will not approve a document containing the current discussion. If the BCSA Group wishes to discuss the appropriateness of congener-specific PCB analysis, then we should arrange for a separate meeting on the subject.

   Response: The text of the Work Plan has been revised substantially to address EPA comments.

2. The Work Plan proposes the use of several different pieces of equipment, including turbidity probes, ADV, and ADCP to collect a variety of data that are each a surrogate for TSS (turbidity, acoustic backscatter, etc.). Which surrogate will be preferred when estimating TSS concentrations? How will differences in predicted TSS from the various surrogates be handled? The ADCPs will not collect data close to the sediment-water interface or close to the water surface; what assumptions will be made to account for these gaps when estimating fluxes?

   Response: The approach to characterization of suspended particulate concentrations in the BCSA is based on multiple lines of evidence to extrapolate TSS concentrations from both optical turbidity (NTU) and acoustic backscatter (ABS) measurements. Both measurements have strengths and weaknesses and neither has been identified as a preferred method. The data analyses to date has shown that the TSS concentrations estimated by both methods compare favorably and that both methods provide a reliable technique for estimating suspended solids fluxes. While the NTU measurements from the moored stations are collected at a fixed depth, the ABS measurements from the ADCPs provide an understanding of TSS concentrations across the water column. As such, the ABS provides a more robust understanding of sediment flux through the system.

   It is acknowledged that the bottom-deployed (upward facing) ADCPs do not monitor the bottom 1 m of the water column. The TSS will be extrapolated to the bottom with best available estimates of sediment profiles and turbulence in the water column. This will be an acknowledged uncertainty in the study. The characterization of the water column profile of TSS, even with the omission of the

bottom one meter, provides data at much higher resolution than a typical TSS study. However, near bottom TSS concentrations can be estimated based on ABS measurements recorded during the transecting events which use a boat-deployed, downward-facing ADCP. These measurements provide an understanding of near bed TSS concentrations that will be considered in estimating sediment fluxes.

3. It is hard to understand which efforts have been completed when reading this document. It treats them all like future efforts. In addition there are some statements that are residual from earlier versions of the work plan, such as Section 7, p -7-2, item 7, discussion of approval of work for July 2010.

   Response: A listing of completed and pending tasks/subtasks will be attached to the Revised Work Plan. Tasks completed during the Summer/Fall 2010 are referred to as "Phase 2a" in this response to comments, and tasks planned during the Spring/Summer 2011 are referred to as "Phase 2b". In addition, a track changes version of the document will be provided again to illustrate where changes of scope have been made. Section 7 has been updated accordingly.

<u>Specific Comments</u>

4. <u>Page 3-8, bottom paragraph:</u> Will the Laser In Situ Scatter and Transmissometry (LISST) sampler be used to determine settling speeds as well? At what depth will the LISST be deployed? Will an attempt be made to determine the grain size variability at multiple depths in the water column?

   Response: LISST measurements were recorded during four transecting events in Phase 1 and will be recorded during one of the storm surge transecting events in Phase 2b. Settling speeds will be determined based on data collected with both the LISST and the ADVs deployed as part of the high resolution ADV sampling program.

   During the Phase 2 long-term deployment, the LISSTs were/will be installed at the surface YSI depth at stations MHS-01 (2.65 m above sediment surface) and MHS-06 (0.86 m above sediment surface). During transecting, particle size measurements are recorded as the LISST is lowered from the water surface to immediately above the sediment bed and raised back to the surface. This provides a detailed characterization of the suspended particulate size distribution as a function of depth.

   The LISST instruments were/will be used to characterize the particle size of suspended particulates both during long-term (1-month) deployments and during mobile transecting events. During Phase 1, the LISSTs were deployed at the same depth as the YSI water quality instrument at stations MHS-03 (0.2 m above sediment surface) and MHS-04 (1.86 m above sediment surface).

5. Page 3-12, Section 3.1.3, Scope of Work and Investigative Methods: If the collection of TSS samples is to be conducted along with mooring maintenance and data retrieval, care should be taken to coordinate the work such that maintenance of the moored equipment doesn't resuspend sediment into the water column and inadvertently bias the TSS sample results. If should be allowed to elapse for conditions to return to ambient levels prior to the collection of water column samples.

   Response: Routine maintenance/calibration of the water quality meters at all moored stations is completed prior to any sample collection. This ensures the TSS/TOC/DOC (POC) samples are collected when the turbidity data are being read by a freshly-calibrated probe. TSS and organic carbon samples will be collected at least one day following station maintenance and YSI calibration, when conditions should be reflective of ambient levels.

6. Section 3.1.4, page 3-14: What is the decision process for mobilizing a jon boat in LBC or a technician with a hand-deployed sensor to the EnCap Road culvert to monitor the dye's progress in LBC?

   Response: Concurrent with the submittal of the draft Phase 2 Work Plan (October 2010), the BCSA Group's contractor WET Labs, who will be leading the implementation of the dye study, conducted a thorough site visit to assess site-specific constraints. Based on their observations during this visit and subsequent discussions with the project team, it was determined that neither the use of a jon boat nor a hand-deployed sensor to monitor the dye progression in LBC was feasible. Because the sensors are specially manufactured, addition of another sensor to the program requires considerable lead time and expense. The sensor that will be affixed to the primary investigation boat would have to be dismounted for use in LBC. This process would be time-consuming and eliminate the ability to monitor the other sections of the BCSA (BCC, MBC, UBC) during this time. It was determined that, instead, the sensor from station MHS-01 in BCC would be moved to a location in the upper portion of LBC (MHS-03).

   It is important to note that dye studies typically do not involve the use of fixed sensors and rely solely on synoptic measurements and/or samples collected from a boat mobilized through the area of interest. Moving the sensor from MHS-01 to LBC (MHS-03) will not compromise the study, as the confluence of the BCC with the Hackensack River will be a primary focus of the vessel-based measurements and sample collection. Vessel-based measurements will also be taken periodically at the mouth of LBC, immediately downstream of the Transco pipeline bridge. However, vessel-based monitoring will only be conducted in LBC upstream of the bridge if time permits.

7. Section 3.1.4 and Figure 3-5: The Work Plan states that dye concentration monitoring in LBC will be limited due to access constraints. A dye fluorescence sensor installed in mooring MHS-02 should be considered, which would yield a more complete hydraulic evaluation.

Response: Please see the response to Specific Comment 6.

8. Section 3.1.5, p 3-14: Please explain why a higher energy system would have a thicker fluff layer – wouldn't it wash away more readily?

   Response: To clarify, the work plan states that "…the fluff layer in the BCSA is thin (<1 cm), a finding that is consistent with the low energy of this type of estuarine environment". This statement was not intended to imply that the thickness of the fluff layer is a direct function of the system energy. In general, fluff layers are more commonly expected in low-energy, estuarine systems where energies are sufficient to re-suspend the fluff particulate, but low enough during long slack periods to let the layer reform. A slight increase in energy can be responsible for a thicker fluff layer as more material is capable of being mobilized regularly. This is in no way meant to imply that a high energy system, unlike the BCSA, would maintain a fluff layer without advection occurring.

9. Section 3.1.5, page 3-14: In the general discussion of sediment resuspension and deposition, please identify and discuss other mechanisms for sediment resuspension and deposition, including the transport of solids into BCSA with the flood tide, exchange of solids with the tidal excursion, and the potential for erosion of BCSA sediments during storm/tide surge/high flow/wind events. In addition to the storm surges mentioned in other sections of the Work Plan, strong winds from the west, when they occur, act to push water out of the NY/NJ harbor, draining Newark Bay and its interconnected waterways. Greater erosion and resuspension may be experienced during various high flow/high velocity events.

   Response: This section has been updated accordingly.

10. Section 3.1.5: Acoustic Doppler Velocimetry (ADV) signal outputs include the combined effects of turbulent velocity fluctuations, Doppler noise, signal aliasing, turbulent shear, and other disturbances. Chanson et al. (2008; Flow Measurements and Instrumentation 19: 307-313) demonstrated that the ADV cannot be used without suitable post-processing in unsteady flows. They further suggest that classical despiking techniques are not applicable. Please explain how the data will be post-processed to achieve the project's objectives.

    Response: During the analysis of the particle settling velocities from the ADV data, the vertical component of velocity is the parameter of interest. With respect to Doppler noise, Chanson et al. (2008) indicate that the "vertical velocities were small and these [noise] effects were deemed negligible." Estimates of eddy diffusivity utilize the horizontal components of velocity. Therefore, the recommended three-step ADV data post-processing steps of Chanson et al. (2008) were/will be employed for horizontal velocity components. These steps are: 1) Low correlation samples are removed, 2) Major disturbances are removed (pre-filtering), and 3) Data are de-spiked, with steps 2 and 3 using similar low-pass/high-pass filter threshold

techniques as described by Chanson et al. (2008). However, please note that Doppler noise and aliasing errors are expected to be (and have shown to be based on preliminary analyses) much lower in the BCSA data set as compared to those presented by Chanson et al. (2008) due to the significant differences in estuarine environmental conditions between the Chanson et al. and BCSA field deployments. The turbulence conditions encountered during the ADV deployment of Chanson et al. (2008) were significantly greater than those at the BCSA, with mean velocities of 1 m/s by Chanson et al. compared to 0.1 m/s in the BCSA. Additionally, significant boat and bird traffic was encountered by Chanson et al., which is not the case at the BCSA.

11. Section 3.1.5, page 3-14: The proposed ADV deployment should be expanded to include at least one high flow event, consistent with other data collection efforts to characterize internal and external sources of solids loads to BCSA.

    Subsequent Clarification: The comment was withdrawn after discussion.

    Response: No response necessary.

12. Section 3.1.7, page 3-17: How will the Sedflume cores be subsampled for bulk density and other analyses while maintaining the integrity of the core needed for the Sedflume testing? Will additional cores be collected for analysis?

    Response: Small subsamples will be collected from the same 4" x 6" core as per standard Sedflume procedure. The subsamples will be collected using a small laboratory spatula. This is standardized and accepted in the laboratory certification to preserve the integrity of the core. The procedures are outlined in the SEI laboratory manuals included in the QAPP.

13. Section 3.1.7, pages 3-17 to 3-18: Sedflume analysis should also be conducted on collocated cores ("duplicate" cores).

    Response: The current design targets local morphologic regions to maximize the characterization of site trends. In order to assist understanding the variation at locations and reduce the uncertainty in the measurements, 4 duplicate cores have been added (25%). These cores will be located in the different morphological environments (deep channel, channel, and mudflat) in the sampling area to improve the quantitative understanding of each area.

14. Section 3.1.7, pages 3-17 to 3-18: Please explain why a density profiler is not proposed for use with the Sedflume cores. What is the impact of not using a density profiler on the characterization of the relationship between erosion rate and ancillary parameters, such as bulk density?

    Response: The density profiler requires an active radioactive source which is highly difficult to transport across interstate lines. X-ray techniques have been developed,

but are presently only available through government laboratories. The proposed approach of collecting subsamples for analysis of bulk density is the standardized method for Sedflume studies. The study will not be adversely impacted by not using a density profiler.

15. Section 3.2.1.2, Page 3-22: The Work Plan indicates that water samples will be collected at a depth equivalent to 60% of the total water column depth. In comparatively deeper waters of the BCSA, an attempt to collect depth-integrated samples should be conducted, which would be more representative than single-depth sampling.

    Subsequent Clarification: The Work Plan needs to demonstrate that the empirical model will not over-estimate or under-estimate the contaminant flux when one water column concentration is applied to the model run and the cross-section.

    Response: As discussed in the February 24, 2011 work session in Edison, NJ, the discrete characterization of vertical COPC gradients in the shallow BCSA surface water has generally not been an objective of RI activities. For several conceptual reasons, the vertical COPC gradients are not anticipated to be significant. These reasons include (i) the generally shallow waterways (many samples in tributaries are collected from water columns that are less than 1 m in depth, and it is difficult to find waterway sampling locations that exceed 5 m in depth), and (ii) the lack of stratification in the waterways as demonstrated by hydrodynamic monitoring data to date. It is true that elevated turbidity readings are observed at a greater depth in the water column, which may lead to higher COPC concentrations. However, the gradients are generally small due to the shallow relatively well-mixed water column. Additionally, the smallest particles, with which the COPCs are typically strongly associated, are most uniformly distributed in the water column as seen in the particle size distributions from the LISST profiles collected during the transecting events. Therefore, the evidence to date suggests that the standard protocol of 60% depth, as recommended by the USGS and EPA for water quality sampling, adequately characterizes the water column transport.

    The Modeling Plan, submitted in February 2010 as Appendix H to the Phase 1 Report, indicates that empirical modeling approaches will be used to evaluate COPC exchange among system components (i.e., marshes, tributaries, etc.). Because our sampling approach provides for representative sampling results, the empirical modeling approaches will, in turn, be representative. As necessary, data gathered describing the vertical distribution of suspended particulates (e.g., acoustic backscatter from the deployed ADCPs, turbidity and suspended solids particle size distributions measured through the water column during transecting) will be applied in conjunction with measured COPC fractionation (total vs. dissolved samples) to assess the potential influence of vertical gradients on COPC exchange.

    Note that Phase 2b surface water activities will include manual surface water sampling at two separate depth horizons during storm surge events (Section 3.2.2.4); hence, vertical gradients can be evaluated based on this planned dataset.

Additionally, note that most of the Phase 2 surface water data collection was completed as of December 2010.

16. Page 3-24, 2nd paragraph: "The average tidal flushing time for the BCSA is estimated to be approximately 15 hours, although it is increased for neap tides and decreased for spring tides." It seems as though the opposite would be true.

    Response: The sentence has been modified as requested.

17. Section 3.2.1.3, p. 3-25: Event driven, time-composite water column samples are to be collected during the Phase 2 program. It is anticipated that the during a storm event, water volume/discharge will vary on the rising and falling limb of the hydrograph, and in the main water body as well. Will composites be flow-weighted to appropriate represent this variability?

    Subsequent Clarification: The comment would apply only to any non-tidal tributaries during storm events. Flow-weighted water column composites should be considered to model any non-tidal tributary loads.

    Response: There is no automated sampling to be performed in non-tidal tributaries.

18. Section 3.2.2.1, p 3-27, 1st sentence: This statement needs better qualification as the highest sediment concentrations are actually found in the waterways at depth.

    Response: The statement was intended to draw a comparison between shallow sediment concentrations in the waterways and marshes. Consistent with the comment, this statement will be qualified to more properly reflect the distribution of COPCs in sediment.

19. Section 3.3.1, p 3-33: We are no longer including the BAZ – 15 cm samples. This will hamper conducting analyses on a consistent basis across study segments (0-15 cm). Although Region 2 did not adopt the CSTAG recommendation that we use a consistent 0-10 cm surface sediment segment, this entirely eliminates the ability to calculate the value for such a consistent segment (0 – 6 inches was mentioned in the CSTAG response).

    Response: The sediment sampling program at the BCSA is more detailed than the typical site where generic criteria are more routinely applied. BCSA sampling increments are site-specific and specific to the relevant risk assessment questions. Through the Phase 1 sediment profile imaging (SPI) survey and physical/chemical characterization, we have clearly identified a small but noticeable difference in BAZ thickness between UBC and the lower three study segments. The BCSA Group is confident the two depth increments of the BAZ are functionally comparable and appropriate.

20. Section 3.3.1, Page 3-33: The Work Plan states that low resolution cores will only be advanced to a depth of 60 cm because concentration gradients in deeper strata stabilize

(based on previously collected data). Phase 1 only characterized the top 1m of the sediment. Although there may be indications of a consistent concentration trend with increasing depth, the depth of contamination has not been confirmed. It would be helpful to collect and analyze a subset of deeper cores that penetrate to the native clay layer, so that deeper contaminant concentrations and the total depth of contamination can be characterized.

Response: In the Phase 1 waterway sediment coring program, which consisted of 27 BCSA cores augmented with six existing Universal Oil Products (UOP) Site cores, eight of the 33 total cores penetrated the Pleistocene clay/silt layer. Additionally, in the upcoming Phase 2b high-resolution waterway sediment coring program of seven cores, provisions are in place to sample and analyze sediments to depths of up to 2 m as needed; these cores are sufficiently deep to likely encounter Pleistocene sediments in at least some if not most locations based on the sub-bottom profiling work previously completed. Hence, between these two programs, we will have a strong understanding of the vertical extent of COPC distribution.

21. <u>Section 3.3.4, page 3-39:</u> It is recommended that COPC analysis for the 10 cores to be radiodated be conducted on the same intervals as the Cs-137 and Pb-210 analyses (i.e., in each 3 cm segment for the upper 30 cm and in each 4 cm segment from 30-38 cm). Adequate sample volume could be obtained by using a large box corer since the total coring radiodating and COPC data should be from the same depth intervals. The text appears to indicate COPC analysis from 0-5 cm, 10-15 cm, 15-25 cm, and 35-50 cm intervals; please clarify.

    Response: The scope of work discussed in this comment was performed in Phase 2a (Summer/Fall 2010). The objectives of the marsh sediment coring program do not include obtaining a fine degree of characterization of COPCs with depth in the sediments. In addition, the BCSA Group does not see value in this degree of characterization due to the stability of the Phragmites marshes, as documented in past studies (e.g. Weis et al., 2005; ELM, 2008).

22. <u>Section 3.3.6, p. 3-43:</u> The objective in the fourth bullet does not seem appropriate. Developing historical profiles using cesium-137 dating assumes deposition. Resuspension events can limit the ability to date such cores. Accordingly, high resolution cores would not yield much information on sediment resuspension events.

    Response: As discussed in Work Plan Section 3.3.6., the Phase 2b high-resolution cores will target locations in which extensive deposition has already been documented. The datasets collected from these cores (COPC profiles, Cs-137, Pb-210, Be-7) will be collectively evaluated to identify evidence of resuspension throughout the core at each core location. This analysis may include identification of changes in deposition rates or COPC profile patterns that could indicate mixing of sediments through resuspension.

23. Section 3.3.6, p. 3-43: Please include the clarification of how the 91% number was calculated.

Response: In the existing dataset of 33 geochronology cores (BCSA Phase 1 and UOP Site cores), the five cores out of 33 for which depositional behavior was not identified were denoted as such in the site Geographic Information System (GIS). For each of the 5 cores, the areal extent of waterway sediments in the vicinity of the core that is interpreted to have the same, no net change behavior was estimated by drawing a neighborhood around the core that has the same bedform setting as the core itself. The total area of such neighborhoods plus the total area of waterway bathymetric pools systemwide (pools are assumed to experience no net change as a general rule) was found to be 9% of the BCSA waterway footprint. Hence, the remainder of the system, or 91% of the waterways, was assumed to be depositional. This analysis is summarized in Section 2.1.4.3 of the Phase 1 Report.

24. Page 3-54, Digital Camera Monitoring: Please include the reason behind discontinuing the human use camera study in LBC.

Response: Human access to large portions of LBC is restricted from both water and land. Water access is limited due to low clearance at a bridge crossing located near the lower reach of LBC. Land access is limited by the presence of landfills along much of the reach. The RI team judged that a camera placed in a more active reach of the study area would provide more meaningful data on site use. For these reasons, the camera survey point was removed from LBC. An additional camera was placed in BCC, which does not have barriers to boat travel, and at Patterson Plank Road Bridge, where greater human activity has been observed or is expected, given access considerations.

25. Section 3.5.4, p. 3-58, item 3: Bioaccumulation modeling should not only be discussed in the BERA as it is important to understanding availability of contaminants in the system.

Response: The text of the Work Plan has been changed to indicate that bioaccumulation data will be used in the RI to understand chemical bioavailability in the Study Area.

26. Page 3-70, 3.6.2, 2nd and 3rd bullets: Were these observations made in both the 0-5 cm and 10-15 cm intervals?

Response: The bullet list will be revised to further describe metals concentrations with respect to sample interval depth. Total mercury, chromium, cadmium and zinc concentrations were elevated above waterway concentrations in the 10 to 15 cm depth interval while concentrations in the 0 to 5 cm interval were comparable to waterway concentrations. Manganese concentrations were elevated above waterway concentrations in both intervals.

27. Page 3-75, 3.7.1, last paragraph: EPA requests more details about the desktop study to estimate atmospheric loading to the BCSA.

    Response: The objective of the desktop study is to expand on the findings presented in Section 2.5 of the Phase 1 Report by providing a quantitative and media-specific accounting of the mercury and PCBs that enter the system from the regional airshed. Data sources to be considered in this analysis include measurements of mercury and PCBs deposition published in both peer-reviewed and agency documents (e.g., New Jersey Atmospheric Deposition Network, etc.). This information will be used to understand regional airshed contribution to chemical load in surface water and sediment. Regional atmospheric contributions to the BCSA are reflective of urban background and will continue to influence surface water and sediment concentrations following remedial actions. This information will be considered during the analysis of remedial alternatives at the site.

28. Page 3-78, 3rd paragraph: A kayaker was identified as the most highly exposed pathway above the surface waters in BCSA. Swimming was identified as a future exposure pathway. EPA suggests collecting ambient air data at the proposed 1 m. height in addition to just above the water surface (5 cm.) as would be an appropriate breathing zone for a swimmer.

    Response: As discussed and agreed upon during our meeting with USEPA in Edison, New Jersey on February 24, 2011, the Group will evaluate potential exposures to an overboard kayaker and swimmer by modeling air concentrations in the breathing zone near the air-water interface. A conservative modeling approach will be used to ensure that potential exposure concentrations are not underestimated.

29. Section 6.3, p. 6-3, Please revise sentence to read, "The evaluation will draw upon, among other things, recent studies on the success and efficacy….."

    Response: The revision will be made as requested.

30. Figure 3-15, Location of Phase 2 Sample Locations in Candidate Reference Sites: The green square with bold borders has been selected to indicate a Marsh COPC Core (0-15cm) with a full suite of analyticals. While 4 of these samples will be collected in both Bellman's Creek and Woodbridge River, only 1 is proposed for Mill Creek. EPA suggests collecting a full suite of analyticals from all 3 proposed sampling locations in Mill Creek.

    Response: As background to this comment, note that in Phase 2a reference site marsh sediment samples were collected in 21 locations across the three sites. The nine locations across these 21 total locations for which full suite analyticals were specified constitute an atypically high percentage of full suite data (43%, compared to the 10-20% typically specified in Phase 2 work). The reason why such a high frequency was specified pertains to the lack of marsh sediment data altogether in

the Phase 1 program; hence, Phase 2a aimed to collect an ample dataset of full suite analyses to support statistical analyses.

Initially, full suite sampling locations were allocated to references site reaches established based on measured salinity concentrations. Since Bellman's Creek and Woodbridge River each have three distinct salinity reaches, three full suite locations were allocated to each site, whereas only one location was allocated to Mill Creek due to its limited salinity variability and single reach. The Bellman's Creek and Woodbridge River allocations were increased to four each to better evaluate variability within these sites in the final version of the Phase 2 Work Plan.

To summarize, the uneven allocation of full suite analyses across the reference sites primarily stems from the varying number of salinity reaches across the sites.

Additionally, as noted above, this work was already performed in Phase 2a in Summer/Fall 2010.

31. <u>Page 8-4, References:</u> The Silkworth reference is not in alphabetical order.

    Response: Text referencing the Silkworth document has been removed in response to a separate EPA comment. The Silkworth reference has therefore been removed from the document.

32. <u>Figures 3-6 and 3-7:</u> Some of the waterways and tributary autosampler locations (shown in yellow) are difficult to discern. Please add an outline or other emphasis to the symbols.

    Response: Symbols identifying waterway and tributary autosampler locations will be modified to be more visible.

EPA Comments on the
Phase 2 Addendum
Quality Assurance Project Plan/Field Sampling Plan (Rev 1)
February 3, 2011

1. **WS #12, Measurement Performance Criteria Table:** It appears that TestAmerica Pittsburgh is performing the AVS/SEM for the sediment samples, but the corresponding information related to the SEM was not provided.

   Response: The SEM portion of the AVS/SEM analysis is performed using standard metals analyses. Test America will analyze metals using methods 6010 or 6020 and mercury using Method 7470. Methods 6010 and 6020 are present in the QAPP and Method 7470 has been added.

2. **WS #12, General Comment for all Parameters:** Include "data completeness check" in QC Sample list for all parameters with measurement performance criterion "≥90% sample collection and ≥90% laboratory analyses."

   Response: The worksheet will be revised where applicable.

3. **WS #12 and WS #28, General Comment for all Parameters:** QC Samples should be consistent between WS #12 and WS #28. For example, in WS #12 (page 1) per SW-846 Method 9081, there are 12 "QC Sample" parameters listed; however, in WS #28 (on page 1) only one "QC Sample" parameter (Method Blank) is listed for SW-846 Method 9081.

   Response: Response: WS#12 is not meant to be identical with WS#28. WS#28 is only to describe the laboratory QC samples. According to the UFP QAPP guidance, WS#12 should describe the QC samples *and activities* related to quality assurance per each method. The headers in WS#12 have been changed to reflect this.

4. **WS #12, General Comment on MS/MSD:** Correct the data quality indicator for the MS and MSD. These QC samples only assess potential error in the analysis, which is denoted by the data quality indicator "A", not sampling (denoted by the data quality indicator "S").

   Response: The correction will be made as requested.

5. **WS #12, General Comment on Field OA/QC Samples:** Correct the data quality indicator for the source blank, equipment blank, trip blank, filter blank and field duplicate. These field OA/QC samples assess potential error in both sampling and analysis (which is denoted by the data quality indicator "S&A").

   Response: The correction will be made as requested.

6. **WS #12, page 13 and 14, Pesticides:** Revise listed frequency of Method Blank, LC Sand MS/MSD to "Prepared and analyzed with each batch of 20 or fewer samples."

Response: The revision will be made as requested.

7. **WS #12, page 19 and WS #28, page 23, TOC, DOC and POC:** Correct the measurement performance criteria for the method blank on WS #12 and WS #28 to "No analytes > PQL."

   Response: The correction will be made as requested.

8. **WS #12, page 20, TOC, DOC and POC:** Correct the data quality indicator for the laboratory duplicate. This sample only assesses potential error in the analysis (denoted by the data quality indicator "A"), not sampling (denoted by the data quality indicator "S").

   Response: The correction will be made as requested.

9. **WS #12, page 27, Sulfate:** Per TestAmerica lab SOP PT-WC-019, page 14, "the control limits for LCS are 80-120% recovery." The information needs to be consistent through WS #12 and WS#28.

   Response: Worksheets #12 and #28 will be checked for consistency and accuracy on this issue. Corrections will be made where appropriate.

10. **WS #12, page 28, Sulfate:** Per TestAmerica lab SOP PT-WC-019 or SW-846 9056, correct the frequency of the MS/MSD to "one MS/MSD per QC batch up to 20 environmental samples."

    Response: The requested corrections will be made as applicable.

11. **WS #12, page 28, Sulfate:** Per TestAmerica lab SOP PT-WC-019 or SW-846 9056, include a laboratory duplicate in the measurement performance criteria for the sulfate analysis. Per the TestAmerica SOP, "A sample duplicate must be performed at a frequency of once per every ten samples. The percent difference must be <10%." This text should be added to both WS #12 and WS #28.

    Response: Worksheets #12 and #28 will be revised as requested.

12. **WS #28, page 34, Sulfate:** "MS/MSD" is listed twice in the "QC Sample" list. Please revise.

    Response: The revision will be made as requested.

13. **WS #12, page 30 and WS #28. page 36, Nitrate and Nitrite:** Per TestAmerica lab SOP PT-WC007 or EPA 353.2:
    a. Revise measurement performance criteria for LCS to "The control limits are 90-110% recovery. If LCS duplicate is analyzed, LCSD must be recovered within +/-10% of the true value and must have an acceptance RPF of <20% with the LCS".

b. Revise LCS frequency to "Each day of analysis with each batch of 20 or fewer environmental samples. A LCS duplicate is used to demonstrate batch precision when the client has not supplied sufficient sample to prepare an MS/MSD sample analysis."

Response: Worksheets #12 and #28 will be revised as requested.

14. **WS #28, page 37, Total Sulfide:** Per WS #12, page ii, Total Sulfide is to be analyzed in both surface water and sediment matrices. This information needs to be reflected on WS #12, page 37. Please revise the matrices for total sulfide to "surface water and sediment."

    Response: The worksheet will be revised as requested.

15. **WS #12, page 33, BOD:** Per the TestAmerica lab SOP, correct the measurement performance criteria for seed blank to "The calculated BOD in the seed blank must be less than or equal to the practical quantitation limit."

    Response: The correction will be made as requested.

16. **WS #12, page 33 and WS #28, page 42, BOD:** Per the TestAmerica lab SOP, correct the measurement performance criteria for laboratory duplicate to "the acceptance range is <20% RPO."

    Response: Worksheets #12 and #28 will be corrected as requested.

17. **WS #28, page 47, TSS:** Per WS #12, Page 35, correct the QC sample parameter to only a "Laboratory control sample (LCS)".

    Response: The correction will be made as requested.

18. **WS #28, page 50, Percent Lipid:** Per the lab SOP, revise the measurement performance criterion for the laboratory duplicate to "RPO≤20%."

    Response: The correction will be made as requested.

19. **WS #12, page 37, Moisture Content:** Revise the analytical method/SOP reference for moisture content to "SM 2540G (Moisture Content)."

    Response: The correction will be made as requested.

20. **WS #12, page 38, AVS/SEM Sulfide:** Per the TestAmerica lab SOP PT-WC-008, revise the measurement performance criterion for the method blank to lithe method blank result must be less than two times the practical quantitation limit."

    Response: The correction will be made as requested.

21. **WS #12, page 40, Cyanide:** Per the TestAmerica lab SOP PT-WC-018, correct the measurement performance criterion for the method blank to "must be free of CN down to the practical quantitation limit."

    Response: The correction will be made as requested.

22. **WS #12, page 40, Cyanide:** Per the TestAmerica lab SOPPT-WC-018, add a laboratory duplicate parameter to the QC Sample list at a frequency of one per QC batch of 20 or fewer samples. The percent difference must be within ± 20%.

    Response: The correction will be made as requested.

23. **WS #12, page 42, TCLP:** Per the lab SOP, correct the measurement performance criteria for the method blank to "No analytes > PQL."

    Response: The correction will be made as requested.

24. **WS #12, page 42 and WS #28, page 57, TCLP:** Per TestAmerica lab SOP PT-OP-004, Page 12, include LCS and MS/MSD parameters in the QC Sample lists. The frequency and measurement performance criteria must be consistent with TestAmerica lab SOPPT-OP004.

    Response: Worksheets #12 and #28 will be corrected as requested and checked for consistency.

25. **WS #28, page 57, TCLP:** Revise correction action for method blank to "consult the individual analysis SOPs for the blank acceptance criteria." Revise the QC acceptance limit for the method blank to "No analytes > PQL."

    Response: The corrections will be made as requested.

26. **WS #12, page 44 and WS #28, page 59, Radionuclides:** Correct frequency of laboratory duplicate to "a minimum of one or designated number of client's samples per batch of 20 samples."

    Response: The correction will be made as requested.

27. **WS #12, page 55 and WS #28, page 73, Methyl Mercury:** Per EPA method 1630, include a surrogate parameter on the QC Sample list with a frequency of one per batch. The percent recovery should be 50-150% for water samples and 30-127% for solid samples.

    Response: The correction will be made as requested.

28. **<u>WS #28, page 73, Methyl Mercury:</u>** Correct the measurement performance criterion for the MS/MSD to "65-135% recovery for aqueous and RPDS 35% for aqueous matrix. Recovery limits for solid samples are in-house generated."

Response: The correction will be made as requested.

29. **<u>WS #12, page 58, Wet Chemistry:</u>** Correct the data quality indicator for the laboratory duplicate. The sample only assesses potential error in the analysis (denoted by the data quality indicator *"A"),* not sampling (denoted by the data quality indicator "S"*).*

Response: The correction will be made as requested.

30. **<u>WS #12, page 59, Wet Chemistry:</u>** Correct the data quality indicator for the initial calibration. The sample only assesses potential error in the analysis (denoted by the data quality indicator "A"), not sampling (denoted by the data quality indicator "S").

Response: The correction will be made as requested.

31. **<u>WS #12, page 62-66, Geotechnical Parameters:</u>** Combine grain size, unconsolidated undrained triaxial compression test, Atterberg limits, moisture content, and loss of ignition into one worksheet and maintain consistency with WS #28, page 78.

Response: WS#28 will be revised to contain the pertinent geotechnical tests in one worksheet consistent with WS#28, page 78.

32. **<u>WS #12, page 67, Dye Study:</u>** Correct analytical group of fluorescence excitation-emissions to "dye study", and maintain consistency with WS #28, page 77.

Response: The correction will be made as requested.

33. **<u>WS #12, page 67, Dye Study:</u>** Revise the measurement performance criteria for the method blank to be consistent with the measurement performance criteria in WS #28, page 77.

Response: The correction will be made as requested.

34. **<u>WS #12, page 67, Dye Study:</u>** Correct the data quality indicator for the method blank. The sample only assesses potential error in the analysis (denoted by the data quality indicator "A"), not sampling (denoted by the data quality indicator "S").

Response: The correction will be made as requested.

35. **<u>WS #28, page 16-22:</u>** There are no corresponding WS #12 tables associated with these pages - please revise as necessary.

Response: Worksheet #12 will be updated with the required information.

36. **<u>WS #15, page TAP-l, VOCs:</u>** Per the TestAmerica lab SOP, the QL for acetone should be 10 ug/L; also please note that Bromochloromethane was not listed in the lab SOP QL Table 1.

    Response: The corrections will be made as requested.

37. **<u>WS #15, page TAP-3, VOCs:</u>** Per the lab SOP, correct the achievable lab QLs for 2-butanone, 2-hexanone, and 4-methyl-2-pentanone to 20 ug/kg.

    Response: The corrections will be made as requested.

38. **<u>WS #15, pages TAP-5 and TAP-6 (SVOC, surface water):</u>** The achievable lab MDLs and QLs for 3,3'-Dichlorobenzide and Hexachlorobenzene are higher than the Marine Water and Fresh Water project action levels. Lower MDLs and QLs are needed to compare the results to the project action levels.

    Response: We will continue to work with the laboratories for the lowest achievable QLs and MDLs. Currently the QLs and MDLs provided in the Worksheets are the lowest that the laboratories can provide for the specified methods.

39. **<u>WS #15, page TAP-l0, Pesticides:</u>** Per the lab SOP, correct the achievable lab QL for Toxaphene to 0.05 ug/L.

    Response: The correction will be made as requested.

40. **<u>WS #15, page TAP-l0, Pesticides:</u>** The achievable lab MDLs for 4,4'-DDD, 4,4'-DDE, 4,4'DDT, Aldrin, Dieldrin, Heptachlor, Heptachlor epoxide and toxaphene are higher than project action levels. Lower MDLs are needed to compare the results to the project action levels.

    Response: We will continue to work with the laboratories for the lowest achievable QLs and MDLs. Currently the QLs and MDLs provided in the worksheets are the lowest that the laboratories can provide. Additionally, matrix interferences due to the presence of PCBs in the samples hamper achieving lower QLs and MDLs due to the necessity for sample dilutions for the specified methods.

41. **<u>WS #15, page TANC-l, Metals:</u>** Revise the QLs for Barium, Copper, Manganese, Vanadium and Zinc to make them consistent with the lab SOP (SOP NC-MT-002, Rev. 4.5, Table VII, page 26).

    Response: The correction will be made as requested.

42. **<u>WS #15, page TANC-l, Metals:</u>** Provide the reference for the project quantitation limits. Review and revise the wording for Note 2 to the table, as appropriate.

    Response: References will be provided and the worksheet will be revised as appropriate.

43. **<u>WS #15, page TANC-9, Methyl Mercury:</u>** Correct the analytical method for methyl mercury shown at the upper left corner of the page to "EPA method 1631E."

    Response: EPA method 1631E is for low level or "trace mercury" analysis. The EPA method for methyl mercury is 1630 and was correct on the worksheet. However, the method for trace mercury was updated to "1631E" from "1631" based on this comment.

44. **<u>WS #15, page PAL-B, Reference Limits and Evaluation Tables:</u>** Correct units in Table Ib title to "ug/L."

    Response: The correction will be made as requested.

45. **<u>WS# 15, Table lc, Marine & Freshwater Tissue Project Action Limits (ug/kg):</u>** The HH Based Action Limit is listed as the Oak Ridge National Laboratory HH SLs but should be cited as US EPA Regional Screening Level Calculator.

    Response: The requested citation will be added to Worksheet #15, Table 1c.

46. **<u>WS #18, page 2 and 3:</u>** Add source blanks and equipment blanks in the 'number of samples' column. Per WS #12, source blanks and equipment blanks are required for some analytes. For example, WS #12, page 50, indicates one source blank and one equipment blank per 20 environmental samples for metals (sediment matrix).

    Response: Equipment blanks were added at a conservative estimate using 1 per 20 samples collected. Fewer equipment blanks may be collected if the frequency of one per sampling day results in less than the 1 per 20 frequency requirement. Source blanks cannot be added easily to this table as they are performed once per lot of water used for decontamination. A conservative number of source blanks was added to the table to attempt to capture the analytical test methods/matrices that require them.

47. **<u>WS #19, page 4:</u>** Correct maximum holding time for TOC to "14 days from time of collection."

    Response: The correction will be made as requested.

48. **<u>WS #23, Analytical SOP References:</u>** The actual SOPs that will be used by Excel Geotechnical and Isotech Laboratories were not provided in the accompanying CD documenting the laboratories SOPs. Worksheet #23 documenting the geotechnical analyses

indicated that they were still in development. The SOPs should be submitted when available. Related to this comment, the appropriate Worksheets #12 and #28 information for the geotechnical analysis should also be provided when the laboratory SOPs are submitted.

Response: Geotechnical laboratory SOPs will be provided for the geotechnical testing that did not follow the ASTM Methods referenced in the QAPP. The corresponding Worksheets #12 and #28 will be revised as appropriate.

Stable isotope method information is provided in the Isotech Laboratory Quality Manual. Discrete SOPs are not provided by the laboratory.

49. **<u>FSP, Section 2.1.1, Page 2-1 and WP Figure 3-5:</u>** The location of the NJSEA Outfall is not easily identified from the aerial imagery. Please mark the location in the figure. How far south of the outfall is the temporary MHS-04 mooring to be placed?

    Response: The NJSEA outfall location will be identified on the figure. Temporary mooring MHS-04 is located 375 feet downstream of the outfall.

50. **<u>FSP, Section 2.3, Page 2-6:</u>** The FSP states that TSS samples will be collected using a peristaltic pump and that samples for DOC and (by extension) POC will be collected using dedicated tubing to support in-line filtering. Please clarify how POC is to be determined and whether filter sizes used for TSS and DOC/POC analysis will be consistent. It is important that the same filter type be used for TSS, DOC, and POC analyses so that the particle fraction analyzed is equivalent and the resultant data are comparable.

    Response: The text of the FSP will be revised to state: "Samples for TOC, DOC and, by extension, POC analyses will be collected. Sample portions for DOC will require filtration and be collected immediately after the TOC portion. Hence, sample collection with a peristaltic pump and dedicated tubing will be performed to support in-line filtering. Filters will be 45 micron disposable filters. POC will be calculated using the resultant values from TOC and DOC analyses."

51. **<u>FSP, SOP2.2:</u>** When an intermediate container is used to fill multiple sample containers, the transfer should occur immediately and the sample should be swirled/stirred thoroughly prior to transfer to prevent suspended solids from settling and introducing a bi-as to the analytical result (due to solids residue remaining in the intermediate container). It is preferable that a peristaltic pump be used to fill all containers directly from the surface water being sampled, where possible.

    Response: SOP 2.2 will be revised to include more detailed instruction on the use of intermediate containers.

52. **<u>Appendix E. Data Quality Objectives.</u>** Table 8 PCB Analysis: There are a number of statements in this section regarding congener-specific PCB analyses with which EPA

disagrees - see Comment 1 on the Phase 2 Work Plan Addendum - Revision 1. Please revise this section appropriately.

Response: The DQOs in this section will be changed in response to EPA's comments.

THE ELM GROUP

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August 27, 2012

-- Via E-Mail and U.S. Mail --

Mr. Douglas Tomchuk
USEPA Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: Berry's Creek Study Area (BCSA)
Phase 3a Work Plan Addendum _ Response to Comments

Dear Mr. Tomchuk:

The BCSA Group has received and completed a preliminary review of the USEPA Conditional Approval of the Phase 3a Work Plan, including the comments provided with the August 16, 2012 letter. Based on that initial review and some recent discussions with you, several comments were identified for response and clarification at this time. Responses to the remainder of the comments will be forthcoming in the upcoming weeks. In addition, ELM will continue to coordinate with you and the USEPA oversight contractor as the approved Phase 3a Work Plan is implemented.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

PPB: ng

Attachment

c: John Hanson, Esq.

The USEPA comments identified for initial responses are provided below in italics and designated by the number they were given in the August 16, 2012 letter. BCSA Group responses are provided below each comment.

15. <u>Pg. 3-5, Sec 3.2.2, 2nd bullet, task 2B</u>: This task is to characterize "BCSA benthic community abundance and diversity to determine if potential COPC exposures have resulted in a change in the community composition compared to that observed at the RI reference areas." Given the highly urbanized nature of these sites, there likely are too many factors involved in determining the benthic community to discern whether COPC exposure can be teased out as a causative, or even a potentially causative factor. This effort may provide support for other lines of evidence, but care should be taken not to overstate in the data quality objectives the ability of this task to differentiate between BCSA and reference area benthic communities.

Response: The Group agrees with USEPA that there are a variety of factors that influence benthic community structure in the BCSA and the surrounding regional urban environment, consistent with literature on the effects of urban environments on benthic community structure. Nonetheless, benthic community structure is widely accepted as a relevant line of evidence to evaluate chemical stressors in urban environments (see for example, EPA 841-B-99-002, and references therein) and is one key component of the sediment quality triad.

The proposed benthic community study is an extension of the work completed in Phase 2 and one line of evidence that will be used to evaluate the potential impacts of site-specific COPCs on the benthic community at the Site. In addition, understanding of the benthic community structure in the BCSA as well as the reference areas is also needed for risk analysis as part of remedial alternatives evaluation. The data quality objectives are being re-evaluated with these considerations in mind.

16. <u>Pg. 3-6, Sec 3.2.1.1, last full paragraph on page:</u> Please include the following endpoints for the Hyalella testing:

- *10-d and 28-d tests: survival and growth with the growth endpoint measured as weight and biomass*
- *42-d tests: survival, weight, biomass, neonates/surviving female*

Response: The endpoints for the 10-d and 28-d test will be survival and growth (measured as dry weight). The endpoints for the 42-d test will be survival, growth (measured as dry weight), and number of juveniles produced per surviving female. Biomass will be directly measured (i.e., dry weight of surviving Hyalella divided by the initial number of organisms) or calculated from the product of survival and weight endpoints. As suggested by the

USEPA, the lead toxicity testing person for the Group will call Dave Mount of EPA-ORD in Duluth to discuss the Group's testing design.

17. <u>Pg. 3-6, Sec 3.2.1.1 Conceptual Basis and Rationale, end of the last paragraph on page:</u> The text states that "The same subset of sediment samples will be used for the 10-day and 42-day toxicity testing." Please clarify the rationale for testing a sediment sample for reproduction if it is found to be acutely toxic (and vice/versa)? It would be better to select 10-d test sediment based on chemistry and 42-d test sediment based on the results of the 28-d testing. Please clarify the path forward for selecting the 10-d and 42-d test samples.

Response: The study is designed to conduct the 28-d test at all locations (total 67; 45 BCSA samples plus 8 duplicates, and 12 reference areas plus 2 duplicates). In addition, 10-d and 42-d tests will be conducted on samples from locations approximating the range of COPC concentrations observed in the BCSA (total 17; 12 BCSA samples plus 1 duplicate, and 4 reference areas).

The 10-d test will be conducted on samples collected from a pre-selected subset of 17 locations that cover the range of COPC concentrations in the BCSA (high to low). Based on the results from these 10-d tests and sediment bulk chemistry data, 42-d testing will be completed on 17 additional samples selected from locations that cover the range of COPC concentrations below that shown to produce significant acute toxicity in the 10-d test or at least have COPC concentrations approximating and below the lower range of those shown to produce acute toxicity.

18. <u>Pg 3-7, Sec 3.2.1.1.1 Sample Locations</u>: The group indicates that data from the previous sampling efforts were used to establish the potential dose range for the toxicity testing program. This needs to be presented more transparently so that the agencies can clearly see the concentration ranges for the "primary" contaminants. The relative ranking system provided (low, med-low, med-high, and high bins) does not provide USEPA with sufficient information to check the appropriateness of the bins. A more quantitative approach to determine the bins, such as use of PEC-Q, or something similar would provide such information.

Response: The sample locations were selected to span the entire length of BCSA and the COPC concentration gradients observed in the waterway sediments. Table 1 summarizes the maximum detected concentrations of key COPCs in the BCSA waterway sediments in the selected sampling areas. The relative rankings of high to low discussed in the Work Plan was developed based on the concentration distribution observed in these areas. Maximum concentrations were ranked from high to low and then divided into distribution quartiles. Locations with concentrations in the top quartile were assigned to the "high" category, those in the lowest quartile were assigned to the "low" category, and two levels of intermediate concentrations developed based on the middle quartiles. Other factors taken into consideration included TOC and AVS/SEM. In addition, the Group will include some additional PCB sediment sampling to ensure the mid-range of concentrations (35 to 99 mg/Kg) is represented, to the extent practical, in the samples selected for laboratory toxicity testing.

Based on the 15 sampling areas distributed throughout the BCSA and the total number of samples that will be tested from these locations (67 total), the Group has a high level of confidence that the toxicity testing data will be representative of the range of conditions for both COPCs and other factors that occur in the BCSA.

20. Pg 3-8, Sec 3.2.1.1.2 Chemical and Parameter Analysis: The group should measure porewater in chemistry-only test beakers that are set up as part of the test. Porewater concentration is a useful dose metric and will improve our understanding of concentration-response relationships over simply using bulk sediment concentration as the dose metric, or by estimating porewater concentrations with equilibrium partitioning assumptions. These measurements can be done using peepers. For the 10-d test, these should be done after 7-days of peeper equilibration. For the 28-d and 42-d tests, there should be two porewater measurements taken along the 28 day time course of the exposure period (still keeping with the recommendation of a 7-d equilibration period for the peepers).

Response: The BCSA Group has developed a field porewater sampling program in Task 2C to support the assessment of the relative bioavailability of primary COPCs to benthic organisms by providing triplicate results for field (i.e., *in situ*) porewater. This approach will support the evaluation of potential relationships between multiple lines of evidence (i.e., laboratory, toxicity, community composition, benthic tissue residues) and relative porewater COPC concentrations as observed across the range of field conditions in the BCSA as well as reference sites.

Measuring laboratory porewater concentrations is not a component of the standard toxicity testing method and is not likely to accurately replicate field conditions for several reasons, including disturbance resulting in complete loss of the natural sediment structure that existed in the field, exposure of the sediment to oxygen causing redox changes, temperature changes, and the introduction of particulates during sampling. Overall, field (i.e., *in situ*) porewater data are considered to be superior to laboratory (i.e., *ex situ*) data for these reasons (Hansen *et al.*, 2005).

The sediment samples used for toxicity testing undergo geochemical changes during handling and over the course of the toxicity testing. These changes alter the laboratory porewater (as well as the accuracy/representativeness of the measurements thereof) in ways that are different from field measurements of porewater. Hence, the addition of porewater measurements from the laboratory will not strengthen the analysis of toxicity testing results in relation to benthic community data and biouptake (tissue concentrations) measured in materials collected directly in the field from the locations where sediments for toxicity testing were collected. Therefore, the Group has not included porewater measurements from the laboratory beakers.

Nonetheless, the Group will consider the addition of porewater measurements from test chambers if a meaningful DQO can be developed related to field toxicity, and a method can be identified for collecting meaningful measurements for the BCSA sediments. Within the next week, the Group will contact you to discuss the intended use of the data (i.e., DQO), and methods for porewater collection that have been successfully implemented by the Agency at other sites with similar sediment characteristics. A final decision regarding whether to add porewater analysis to the Task 2A scope will be made based on these considerations and will need to be reached no later than Friday, September 7 in order to keep to the Phase 3A implementation schedule.

21. Page 3-9, Section 3.2.1.2, Second Paragraph from the top of the page: The sequence of sampling events should be revised. Multiple grabs samples should be collected and homogenized to support the toxicity test and bulk chemistry analyses; however, a separate, discrete grab (not homogenized) should be collected to support the benthic community survey since the act of compositing/homogenizing will likely damage and impact the identification of the benthic organisms. Table 3-2 infers that benthic community samples will be composited with a sub-set of samples analyzed as discrete samples. Please clarify.

Response: Benthic community samples will not be composited with samples collected for other purposes. The SOPs outline a collection program that ensures that care will be taken to maintain discrete samples when processing the samples to be sent to the laboratory for taxonomic identification of benthic organisms.

22. Pg. 3-9. Sec 3.2.1.2 Scope of Work and Investigative Methods: The group should increase the number of samples that will be selected for the 10- and 42-d tests. A minimum of 12 from BCSA and 4 from the reference areas should be included. Also, please clarify the path forward for selecting the 10-d and 42-d test samples.

Response: The Group will increase the number of samples for the 10-d and 42-d tests to 12 from the BCSA and four from the reference areas. See also response to comment # 17.

25. Pg 3-13, Sec 3.2.3 Task 2C – Waterway Sediment Porewater: For mercury and methyl-mercury, the DGTs may provide useful data. However, these tools are still in their early phases of verification, and application by the scientific community. Therefore, another technique should be used to obtain and analyze porewater for mercury. Perhaps in situ application of peepers? Information from the Treatability Study work may alleviate the need for such other analysis. Please clarify the procedure for calculating pore water concentrations from the DGTs.

25. Pg 3-13, Sec 3.2.3 Task 2C – Waterway Sediment Porewater: For mercury and methyl-mercury, the DGTs may provide useful data. However, these tools are still in their early phases of verification, and application by the scientific community. Therefore, another technique should be used to obtain and analyze porewater for mercury. Perhaps in situ application of peepers? Information from the Treatability Study work may alleviate the need for such other analysis. Please clarify the procedure for calculating pore water concentrations from the DGTs.

Response: As indicated in the Work Plan, the porewater sampling approach described for Task 2C was proposed pending the results of validation testing performed for the Treatability Study (TS)/Pilot Study (PS) work, with potential modifications to be proposed based upon the TS/PS findings. Preliminary results for passive mercury sampler testing for the TS have indicated that analytical sensitivity for DGTs for mercury and methyl mercury may not be sufficient for the purposes of the RI. While additional testing is being performed to improve method sensitivity, for the purposes of the Phase 3a RI, the BCSA Group concurs that using the more proven approach of peeper sampling is appropriate for Phase 3a waterway work. The Group is currently developing a detailed implementation plan for this approach and will advise USEPA concerning the extent to which program modifications are necessary.

References:

Barbour, M.T. et al., 1999. Rapid Bioassessment Protocol for Use in Wadeable Streams and Rivers. Periphyton, Benthic Macroinvertebrates, and Fish Second Edition. EPA 841-B-99-002

Hansen, D.J. *et al.*, 2005. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver and Zinc). U.S. EPA, Office of Research and Development. EPA/600R-02011/

Table 1. Candidate Sampling Locations for Sediment Toxicity Program in the Berry's Creek Study Area

Presentation Area	Sub Area	Concentration Categories[a]	Maximum Concentration (mg/kg)[a]				Rank by Maximum Concentration[a]				Sum of Ranks of Maximums
			PCBs	Total Mercury	Chromium (Total)	Zinc	PCBs	Total Mercury	Chromium (Total)	Zinc	
UBC-North	Mud Flats North Ditch	HIGH	18	1100	4800	7300	3	1	2	1	7
MBC-South	Channel Rutherford Marsh	HIGH	10	170	1900	2300	6	2	3	2	13
MBC-Ackermans	Ackerman's Creek	HIGH	120	130	6400	640	1	4	1	8	14
UBC-South	North Peach Island Creek	HIGH	12	130	1300	2100	5	4	5	3	17
UBC-South	Eight-Day Swamp Creek	MEDIUM - HIGH	12	150	1500	1100	5	3	4	5	17
UBC-North	South Nevertouch Marsh	MEDIUM - HIGH	21	57	440	1100	2	6	8	5	21
UBC-South	Paterson Plank Marsh	MEDIUM - HIGH	6.1	93	650	1400	7	5	7	4	23
MBC-Walden	Channel Walden Swamp	MEDIUM - LOW	17	48	730	990	4	7	6	6	23
UBC-East	South Peach Island Creek	MEDIUM - LOW	4.8	38	220	690	8	9	12	7	36
UBC-South	Channel between Nevertouch and Eight-Day	MEDIUM - LOW	2.2	38	320	450	9	9	10	10	38
BCC-Tollgate	North of Tollgate Marsh	MEDIUM - LOW	1.6	18	260	450	10	10	11	10	41
LBC-South	LBC-South	LOW	0.96	8.3	380	600	13	12	9	9	43
MBC-South	Channel South Rutherford Marsh	LOW	1.2	14	210	360	11	11	13	11	46
UBC-North	West Riser	LOW	1.1	43	34	130	12	8	15	13	48
LBC-North	LBC-North	LOW	0.81	3.2	180	300	14	13	14	12	53

Notes:

Only the sediment results from BAZ samples were used for this evaluation.

Maximum total mercury represents the maximum of the sum of mercury plus methyl mercury concentrations. Relative rank is calculated from this value.

Ranks are based on the following:

1 - highest

15- lowest

[a] Concentration Categories were assigned using quartiles of the maximum concentrations according to the following classification:

	PCBs (mg/kg)	Total Mercury (mg/kg)	Chromium (Total) mg/l	Zinc (mg/kg)
HIGH	≥14.5	≥130	≥1400	≥1250
MEDIUM - HIGH	≥6.1-<14.5	≥48-<130	≥440-<1400	≥690-<1250
MEDIUM - LOW	≥1.4-<6.1	≥28-<48	≥240-<440	≥450-<690
LOW	<1.4	<28	<240	<450

Berry's Creek Study Area
Responses to USEPA Comments, November 15, 2012
Phase 3a Work Plan Addendum, Amendment 1

1. Section 2.1.2.1 Passive Sampling Approaches:

a) Please clarify if the PDMS program involving PRC will be also be in the one of the locations for sediment toxicity test samples that will be collected from Area 8.

Response: Yes, PRC PDMS devices will be installed in Area 8 at the locations of the toxicity testing samples. The PRC PDMS samplers will be deployed as a set of four at each of the locations (near-bank, mid-tidal, and subtidal areas of Area 8). One set of four PRC PDMS samplers will also be deployed in marsh sediments in Walden Swamp.

b) Will four PRC impregnated samples be used at each of the three positions (near-bank, mid-intertidal, and subtidal) with a maximum of 6 sublocations to account for the two matrices (sediment and marsh)?

Response: The PRC PDMS samplers will be installed at 3 waterway locations and 1 marsh location to evaluate the degree of equilibrium achieved at the benthic toxicity testing sampling locations and Pilot Study sampling locations. As described in Section 2.7 of SOP 3.7, a set of four PRC PDMS samplers will be deployed in each of 3 waterway sediment locations (Area 8 of toxicity testing program, as described under a above), and a PRC set will be deployed in a marsh sediment (Walden Swamp) to confirm equilibration.

c) Please identify the PRCs that will be employed.

Response: The PRC compounds are deuterated PAH compounds (d12-fluoranthene, d12-chrysene, d12-benzo[b]fluoranthene, and d14-dibenz[a]anthracene) and a deuterated PCB (decachlorobiphenyl; PCB-209).

d) Please clarify the sequencing of the placement of the sampling devices. Are the samplers all placed during initial deployment and retrieve separately based on the specified number of deployment days?

Response: Commercial peepers, custom peepers, and PDMS samplers will be deployed concurrently. Centrifuge samples will be collected during this deployment. Due to a shortage of certified-clean devices, DGT samplers will be deployed approximately 2 weeks after the initial deployment. All sample devices will be collected following the deployment time specified in the Work Plan Amendment.

2. Please provide the centrifugation SOP that will used.

Response: The SOP has been requested from the laboratory and will be submitted to USEPA upon receipt by the Group.

THE ELM GROUP

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December 6, 2012

-- Via E-Mail and U.S. Mail --

Mr. Douglas Tomchuk
USEPA Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: Berry's Creek Study Area (BCSA),
Phase 3a Work Plan Addendum - Response to Comments

Dear Mr. Tomchuk:

The BCSA Group has reviewed the comments provided with the August 16, 2012 Conditional Approval letter for the BCSA Phase 3a Work Plan Addendum. In a letter dated August 27, 2012, the Group submitted responses to several comments that related directly to implementation of the Phase 3a activities. Responses to all of the comments are provided herein. If you have any questions related to these responses please feel free to contact me.

Sincerely,
THE ELM GROUP, INC.

Peter P. Brussock

Peter P. Brussock, Ph.D.
Project Coordinator

PPB: ng

Attachment

c: John Hanson, Esq.

Berry's Creek Study Area
USEPA Comments on Draft Phase 3A Work Plan Addendum
August 16, 2012

General Comments:

1. EPA has previously discussed the need for congener-specific PCB data for the site in order to evaluate risk from a TEQ approach in accordance with EPA guidance/policies. EPA had expected to see a proposal for congener-specific PCB analysis within the Phase 3A program. The Phase 3B Work Plan Addendum will need to contain a congener-specific PCB analysis for all media and of sufficient size necessary to complete the risk assessment.

Response: In the Phase 1 Report response to USEPA comments, the BCSA Group confirmed its agreement to evaluate the congener data from the UOP Site and to evaluate, in consultation with the USEPA, what additional congener data/analysis is needed in Phase 3 to complete answers to relevant technical questions, as well as USEPA administrative requirements for PCB sediment sites. The BCSA Group reaffirms its commitment to collect PCB congener data as part of the Phase 3B assessment.

As noted in USEPA's Contaminated Sediment Guidance (p. 2-4; USEPA, 2005), the need for PCB congener analysis should be based on site-specific considerations. With regard to the site-specific risk assessment, the Group evaluation finds that the site-specific data to complete the risk assessment and support risk management decisions in the BCSA is best met with Aroclor analysis. Support for this determination includes:

- Based on implementation of two phases of the site characterization work approved by the USEPA, the BCSA Group has compiled a substantial dataset of PCB Aroclor concentrations in surface water, sediment and biota throughout the BCSA and the reference areas over four years.
- The PCB Aroclor data are of high quality and have been validated and accepted by the USEPA.
- The BCSA Group recognizes the PCB concentrations in surface water; sediment and biota in a large portion (UBC and MBC in particular) of the BCSA are generally greater than reference area concentrations, regional concentrations and typical cleanup objectives for many contaminated sediment sites with PCBs. Consequently, risk assessment based on Aroclors will provide a clear measure of the risks associated with the BCSA Site compared with references and regional

background, without concern for low level risks being underestimated compared to the congener composition of the PCBs in the BCSA. In addition, there will likely be some uniformity in the relationship between Aroclor and congener-based risk calculations across the Site and reference areas that lead to similar remedial decisions based on the risk analysis.

- Comparison of site data to regional data is a component of the risk analysis, and regional data on PCBs is primarily comprised of Aroclor data.
- The USEPA has stated in meetings that it concurs with the Group's position that risk assessment of PCBs with Aroclor data will be acceptable. The rationale for this determination is provided in the Revised Phase 2 Work Plan Addendum and QAPP Appendix E – DQO (Geosyntec, April 2011).
- With regard to long term monitoring of the PCB trends in media at the site, especially fish tissue, PCB Aroclor data is used at all PCB sediment sites because of its analytical sensitivity to changing concentrations and cost-effectiveness. The Group already has 2 years of baseline monitoring using Aroclors, and likely will have at least double that database when remedy decisions are made.
- BCSA Group review of the limited UOP PCB congener data did not identify any particular indications that assessment of the BCSA site using congener data instead of Aroclor data would yield a fundamentally different management decision. taking into account

The use or Aroclors is entirely consistent with most other sediment sites with PCBs. It provides a consistent basis for risk management decision-making within BCSA, and it will facilitate decision-making during implementation of a BCSA-wide remedy using adaptive management concepts.

Given all these site-specific considerations and the BCSA Group's commitment to collect PCB congener in Phase 3B, the following proposal is made (as discussed in the December 3, 2012 meeting with the USEPA, USFWS and NOAA) to analyze the PCB congeners at the BCSA Site: White Perch would be sampled and analyzed for PCB congeners and PCB Aroclors concurrently with the baseline monitoring program in 2013. The rationale for this proposal is as follows:

- The baseline sampling program includes samples from each study segment and two reference areas.
    - 10 white perch fillet samples per BCSA segment; 40 BCSA samples total.
    - 20 white perch fillet samples from Bellman's Creek and 10 white perch fillet samples from Mill Creek; 30 reference area samples total.

- Several years of PCB Aroclor data have already been collected in a consistent manner to compare to the PCB congener data.
- The focus on white perch is based on their relatively high level connection to the human health fish ingestion pathway in the BCSA (anticipated highest risk human health pathway for PCBs) and the higher level of certainty of the PCB congener risk assessment with human receptors than ecological receptors.
- The conservativeness of the human health assessment and higher level of risk certainty of PCB congeners to human receptors compared with ecological receptors will be protective of ecological receptors if determined to be protective of human receptors.
- Risk calculations will be completed for the fish ingestion pathway with PCB Aroclors and congeners as part of the baseline risk assessment. Differences in the risk estimates will be taken into account in the baseline human health and ecological risk assessment.

As discussed in the December 3 meeting with the USEPA, the data quality objectives for such a testing program will need to be developed further and included in the discussion of the objectives of the Phase 3B PCB congener testing program.

2. Similar to PCB congener analysis and risk assessment, the Phase 3B Work Plan should clarify how the RI/FS will evaluate dioxin and furans. EPA and the BCSA group should work to resolve these issues prior to submittal of the Phase 3B Work Plan Addendum The following link includes tools for dealing with dioxin concerns at a site: http://www.nj.gov/dep/srp/guidance/index.html.

Response: The BCSA Group agrees to provide clarification of how dioxins and furans will be evaluated in the risk assessment in the Phase 3b Work Plan. More specifically, the BCSA Group proposes to use the site-specific sediment data (see Phase 1 Report), regional data and regional risk factors (e.g., fishing and crabbing advisories) to provide an estimate of the relative contribution of dioxins and furans to the total baseline risks and future post-remedial residual risks in the BCSA. To accomplish this, the Group met with the USEPA personnel on December 3 and discussed the significant difficulties associated with incorporating into the BCSA risk assessments consideration of dioxin and furans, as they are primarily a regional concern. Based on the meeting discussion, the USEPA will be providing additional input to the BCSA Group for consideration.

3. There have been continuing discussions of the "reference sites" between the agencies and the BCSA Group without agreement. We hope that the analysis of regional

background concentrations that is supposed to be included in the Phase 2 Report helps resolve the issues. The agencies and the BCSA Group should work to resolve these issues prior to submittal of the Phase 3B Work Plan Addendum.

Response: As reviewed with the agencies (USEPA, USFWS and NOAA) at the December 3 meeting, the Phase 2 report presents additional information regarding the range of chemical and ecological conditions in the reference areas (Bellman's Creek, Mill Creek, and Woodbridge River). Appendix S of the Phase 2 report presents a detailed analysis of the COPC concentrations in the region, including comparison to both the reference areas and the BCSA. This analysis indicates the range of COPC concentrations in the reference areas shows a high degree of overlap with the range of concentrations of COPC concentrations in the region. The Group reviewed the reference areas selection process, the comparison of these areas to the regional sediment condition and presented examples of its intended use of the reference areas in the RI/FS. As a follow-up, the Project Coordinator will discuss the path forward with the USEPA RPM, including identification of any additional data needs that should be addressed as part of Phase 3B work.

4. Sediment toxicity tests in Phase 3a will be conducted using only one species (*Hyalella azteca).* The use of two species for toxicity testing is generally recommended by the agencies, and is documented in NJDEP's *Ecological Evaluation Technical Guidance,* August 2011, Appendix D, available at http://www.nj.gov/dep/srp/guidance/index.html. For the Phase 3b Work Plan Addendum please evaluate the Phase 3a toxicity tests and consider whether additional toxicity tests with another organism would provide sufficiently valuable information.

Response: The process of selecting a test organism for the sediment toxicity testing in the BCSA took into account several factors, such as the range of salinity within the BCSA during baseline conditions and storm events. During baseline conditions, the salinity ranges from freshwater near upland discharges into the tidal area to around 8-10 ppt near the Hackensack River. In addition, the salinity during major precipitation events can change to freshwater throughout nearly all of the BCSA, while during tidal surges with little or no precipitation, the salinity can be much higher than during baseline conditions.

Consequently, selecting a test organism that can tolerate the range of conditions was challenging. Two organisms in particular were identified as potentially tolerant of the site-specific conditions: *Leptocheirus* and *Hyallela*. However, *Leptocheirus* is more of a marine species and the UOP site project team experienced difficulties in working with it, leading them to use *Hyallela.* The BCSA Group's review of the UOP study and consideration of the wider range of BCSA conditions indicated that *Hyallela azteca* would likely provide the best comparative analysis of BCSA sediments in toxicity tests. The results of the Phase 3a toxicity testing will be evaluated as part of a multiple-lines-of-evidence approach, which includes bulk sediment chemistry, community analysis, benthic invertebrate tissue residue concentrations, and pore water chemistry. The need for any additional testing in Phase 3B will take into account the combined findings from these lines of evidence.

With regard to the reference in the comment to the general recommendation that two species be used for toxicity testing, that recommendation is included in the freshwater (salinity 3.5 ppt or less) section of the guidance but not in the marine section of the sediment toxicity testing guidance. The recommendations are understood to be different for the two environments due to the difficulty in matching test species to brackish site conditions.

5. It may be useful to include the measurement endpoint of egg counts (numbers or mass) in select gravid female mummichogs. This endpoint, which is being conducted for the Lower Passaic River Restoration Project, may also be appropriate to assess fish population health at BCSA.

Response: Aquatic community surveys completed during Phase 1 and Phase 2 did not identify substantive differences between the BCSA and reference areas in terms of mummichog abundance, condition factor, or physical abnormalities (Phase 2 Site Characterization Report, Section2.4.2.1). Community composition in the BCSA is also generally consistent with the results of fish community surveys completed by the New Jersey Meadowlands Commission for other locations in the Hackensack Meadowlands (Bragin, 2005). USEPA guidance for ecological risk assessment specifies that "ecological effects of most concern are those that can impact populations (or higher levels of biological organization"(USEPA, 1997) and "the goal of the Superfund program is to select a response action that will result in recovery and/or maintenance of healthy local populations of ecological receptors" (USEPA, 1999), so in the absence of suspected population-level effects, additional assessment of reproductive metrics is not warranted at this time.

6. Marsh invertebrates will be collected in the BCSA and reference marshes to provide additional data to support an assessment of potential risk to song birds (e.g., red-winged black bird). Since the red-winged black bird is typically omnivorous, it may

be appropriate to also include the marsh wren (insectivorous/marsh gleaner) in the ecological risk assessment.

Response: The omnivorous diet of the red-winged black bird (RWBB) during the non-breeding portion of the year integrates exposures at the secondary and tertiary trophic levels. During the spring breeding season, the RWBB diet is primarily comprised of insects (Hintz and Dyer, 1970; Tsipoura et al, 2008), similar to the marsh wren, and therefore represents a similar exposure pathway during this time period. Furthermore, RWBB young are fed only insects (Stanford, 2010), and are therefore an appropriate receptor.

Marsh wren is present in far more limited numbers than the RWBB in the BCSA, based on both informal and formal surveys. Qualitative observations by field staff during the remedial investigation have yielded few sightings of marsh wren throughout the study area. As summarized in the Phase 1 Work Plan, quantitative avian surveys have been completed by others in Oritani Marsh (Barrett and McBrien, 2007; Mizrahi et al, 2007). Mizrahi found that RWBB is more than 25 times more abundant in Oritani Marsh than the marsh wren (770 RWBB vs. 30 marsh wrens observed over a two year period; Geosyntec/Integral, 2009, Table 2-6). This finding is consistent with avian community composition elsewhere in the Meadowlands (Mizrahi et al, 2007).

In addition, RWBB is present in the BCSA year-round, as compared to marsh wren which is primarily found in the Meadowlands during the spring and summer (Mizrahi et al, 2007). Direct avian community measurements in Oritani Marsh confirm this temporal distribution, with marsh wren comprising approximately 20% of all individuals observed in the spring, but only approximately 3% of all individuals observed in the fall (Barrett and McBrien, 2007). The combined factors of insectivorous diet during the breeding season, greater overall abundance, and year-round presence in the BCSA make RWBB a more ecologically relevant assessment endpoint than marsh wren.

Specific Comments:

7. <u>Page 1-2, Paragraph below Imbedded Table</u>: The language regarding the Phase 2 Site Characterization Report should be corrected to present an accurate record. The current language makes it sound like the Phase 2 Report was submitted prior to the Phase 3A Work Plan Addendum, while it actually has not yet been submitted.

Response: Consistent with feedback from the USEPA RPM, no revised Phase 3a Work

Plan will be submitted. The Phase 2 Report was submitted to USEPA by the end of September. A complete timeline that accurately describes what was completed when during the RI will be included in the RI report to be submitted after Phase 3B.

8. Page 1-3, Bulleted List of Task Summary: Please revise the status of tasks in summary list since Task 3 "Routine Monitoring" and Task 4A "Marsh BAZ Macroinvertebrate Evaluation" were completed in July and August 2012.

Response: Please refer to the response to comment #7 in relation to document revisions. The task status summary in the Phase 3a Work Plan was accurate as of the document submission date (July 20, 2012), so no revision is necessary. Tasks 3 and 4A were initiated in July and August in accordance with a partial approval from USEPA (July 19, 2012). A complete timeline that accurately describes what was completed when will be included in the RI report to be submitted after Phase 3B.

9. Page 1-4, Section 1.2: The text states that Phase 3a will support the completion of the site-specific risk assessments. No such statement is included for Phase 3b, so one would assume that the risk assessments will be completed based on the data collected through Phase 3a. However, that is not EPA's current understanding. Please make it clear that the Phase 3b data will be included in the site-specific risk assessments.

Response: The human health and ecological risk assessments will be completed using all data collected during the RI/FS, including data collected in Phase 3b. Scoping of Phase 3b will specifically include an evaluation of what additional data if any are required to complete the risk assessments.

10. Page 3-1, Section 3, Third Paragraph : The discussion of co-located samples is confusing. The importance of co-located samples is well established at contaminated sediment sites.

Response: The intent of the subject text was to point out that extensive sampling has been completed throughout the study area during Phase 1 and Phase 2. While past sampling activities have provided overlapping spatial data coverage for all media, only a subset of previous sampling has focused explicitly on collection of co-located sample data across multiple media (e.g., Phase 2 Task 3C, Sediment Surface Investigation for Correlation to Biota COPC Residues). In contrast, the proposed scope of work for Phase 3a focuses heavily on collection of co-located samples for toxicity testing, pore water, tissue, and community data (Task 2), as well as sediment chemistry (Tasks 5 and 7).

11. Page 3-2, Task 1A, First Paragraph from the top of the page: While it should be clear to those involved in the BCSA project, an unfamiliar reviewer may not realize why manganese is being used to assist in interpretation of marsh-to-waterway exchange. Please elaborate on the rationale for manganese analysis.

Response: The Phase 2 Report provides detailed analysis of manganese, including the role manganese plays in the evaluation of interflow dynamics (Phase 2 Site Characterization Report, Appendix Q, Section 2, pp. 2-1 through 2-7).

12. Page 3-4, Task 1B, Figure 3-2: Please explain the rationale for the number of samples and location of the samples for "specific yield." Why are no samples being collected along Berry's Creek Canal? How will variability among these locations cores be assessed?

Response: Sample locations for specific yield were selected to be proximate to existing marsh well clusters that were installed in Walden Swamp, Eight Day Swamp, and Nevertouch Marsh during Phase 2. Given the similarities in marsh vegetation and sediment physical characteristics, the Group does not anticipate a high level of variability in specific yield throughout the study area. Therefore, samples are not proposed in BCC during Phase 3a.

The specific yield data will be used in conjunction with other site-specific data such as interflow seepage measurements and marsh well data to refine estimates of COPC exchange between the marshes and waterways. Variability among locations will be assessed using graphical analysis and basic descriptive statistics such as range, standard deviation, and central tendency. Field observations such as sediment texture and root density will also be considered in an assessment of variability. If analysis of the Phase 3a data determines that interflow represents a significant pathway of COPC exchange between the marshes and waterways, and if specific yield varies appreciably between sample locations, then additional specific yield measurements in more subareas may be warranted in Phase 3b.

13. Page 3-4, Task 1B, Second Paragraph from the top of the page: Please provide the rationale for why the marsh water level needs to be greater than 20 cm below ground level prior to collecting marsh cores.

Response: As described in Standard Operating Procedure 4.6 for measurement of marsh specific yield (Phase 3a QAPP Addendum, Appendix C), marsh cores will be collected to a depth of 20 cm. The objective of having the marsh water level at a depth greater than 20 cm during sample collection relates to logistical considerations as opposed to measurement requirements. Specifically, under the specified conditions the sample increment will be desaturated, which will minimize the weight of the core and facilitate collection. All cores will be re-saturated as part of the test protocol, as described in SOP 4.6.

14. Page 3-4, Task 1B, Fourth Paragraph from the top of the page and QAPP SOP 4.6: Please clarify whether site-water, tap water, or distilled water will be used to conduct the specific yield bench-top study; provide rationale on type of water selected.

Response: The specific yield test is focused on a physical characteristic only. No chemical analysis is proposed for either the water or the sediment used for this test, so the type of water used is not expected to materially affect the results. Tap water will be used to conduct the specific yield measurements.

15. Page 3-5, sec 3.2, 2nd bullet, task 2B: This task is to characterize "BCSA benthic community abundance and diversity to determine if potential COPC exposures have resulted in a change in the community composition compared to that observed at the RI reference areas." Given the highly urbanized nature of these sites, there likely are too many factors involved in determining the benthic community to discern whether COPC exposure can be teased out as a causative, or even a potentially causative factor. This effort may provide support for other lines of evidence, but care should be taken not to overstate in the data quality objectives the ability of this task to differentiate between BCSA and reference area benthic communities

Response: The Group agrees with USEPA that there are a variety of factors that influence benthic community structure in the BCSA and the surrounding regional urban environment, consistent with literature on the effects of urban environments on benthic community structure. Nonetheless, benthic community structure is widely accepted as a relevant line of evidence to evaluate chemical stressors in urban environments (see for example, EPA 841-B-99-002, and references therein) and is one key component of the sediment quality triad.

The proposed benthic community study is an extension of the work completed in Phase 2 and one line of evidence that will be used to evaluate the potential effects of the range of site-specific COPC concentrations on the benthic community at the Site. In addition, understanding of the benthic community structure in the BCSA as well as the reference areas, both of which are influenced by the general urban conditions, is also needed for risk analysis as part of remedial alternatives evaluation.

16. Page 3-6, Sec 3.2.1.1, last full paragraph on page: Please include the following endpoints for the Hyalella testing:
    - 10-d and 28-d tests: survival and growth with the growth endpoint measured as weight and biomass
    - 42-d tests: survival, weight, biomass, neonates/surviving female

Response: The endpoints for the 10-d and 28-d test will be survival and growth (measured as dry weight). The endpoints for the 42-d test will be survival, growth (measured as dry weight), and number of juveniles produced per surviving female. Biomass will be directly measured *(i.e.,* dry weight of surviving *Hyalella* divided by the initial number of organisms) or calculated from the product of survival and weight endpoints. As suggested by the USEPA, the lead toxicity testing person for the Group will call Dave Mount of EPA-ORO in Duluth to discuss the Group's testing design.

17. Page 3-6, Sec 3.2.1.1 Conceptual Basis and Rationale, end of the last paragraph on page: The text states that "The same subset of sediment samples will be used for the 10-day and 42-day toxicity testing." Please clarify the rationale for testing a sediment sample for reproduction if it is found to be acutely toxic (and vice/versa)? It would be better to select 10-d test sediment based on chemistry and 42-d test sediment based on the results of the 28-d testing. Please clarify the path forward for selecting the 10-d and 42-d test samples.

Response: The study is designed to conduct the 28-d test for all 67 samples (45 BCSA samples plus 8 duplicates, and 12 reference areas plus 2 duplicates). In addition, 10-d and 42-d tests will be conducted on 17 samples including those from locations approximating the range of COPC concentrations observed in the BCSA (12 BCSA samples plus 1 duplicate, and 4 reference areas). The 10-d test will be conducted on samples collected from a pre-selected group of 17 samples that cover the range of COPC concentrations in the BCSA (high to low). Based on the results from these 10-d tests and sediment bulk chemistry data, 42-d testing will be completed on 17 additional samples selected from locations that cover the range of COPC concentrations below those that are shown to produce significant acute toxicity in the 10-d test or at least have COPC concentrations approximating and below the lower range of those shown to produce acute toxicity.

18. Page 3-7, Sec 3.2.1.1.1 Sample Locations: The group indicates that data from the previous sampling efforts were used to establish the potential dose range for the toxicity testing program. This needs to be presented more transparently so that the agencies can clearly see the concentration ranges for the "primary" contaminants. The relative ranking system provided (low, med-low, med-high, and high bins) does not provide EPA with sufficient information to check the appropriateness of the bins. A more quantitative approach to determine the bins, such as use of PEC-Q, or something similar would provide such information.

Response: The sample locations were selected to span the entire length of BCSA and the COPC concentration gradients observed in the waterway sediments. Table 1 summarizes the maximum detected concentrations of key COPCs in the BCSA waterway sediments in the selected sampling areas. The relative rankings of high to low discussed in the Work Plan were developed based on the COPC concentration distribution observed in these areas. Maximum concentrations were ranked from high to low and then divided into distribution quartiles. Locations with concentrations in the top quartile were assigned to the "high" category, those in the lowest quartile were assigned to the "low" category, and two levels of intermediate concentrations developed based on the middle quartiles. Other factors taken into consideration included TOC and AVS/SEM. Based on the 15 sampling areas distributed throughout the BCSA and the total number of samples that will be tested from these locations (67 total), the Group has a high level of confidence that the toxicity testing data will be representative of the range of conditions for COPCs and other factors that occur in the BCSA.

19. Page 3-7, Task 2A, Figure 3-3A: Please provide a discussion regarding how the recent changes (e.g., the tide gate and mobilization for the Non-Time-Critical Removal Action at the UOP site) may impact the location 9a sediment toxicity testing (west side of Ackerman's Creek).

Response: The construction of the tide gate will affect the hydrology of Toxicity Testing Area 9a (west of Murray Hill Parkway), essentially eliminating upstream tidal flows in this area. Sediment removal activities in the NTCRA area at the UOP site will include sediment erosion control measures, so no effect on COPC concentrations is anticipated (i.e., due to construction-related disturbance of higher concentration sediments).

20. Page 3-8, Sec 3.2.1.1.2 Chemical and Parameter Analysis: The group should measure pore water in chemistry-only test beakers that are set up as part of the test. Pore water concentration is a useful dose metric and will improve our understanding of concentration-response relationships over simply using bulk sediment concentration as the dose metric, or by estimating pore water concentrations with equilibrium partitioning assumptions. These measurements can be done using peepers. For the 10-d test, these should be done after 7-days of peeper equilibration. For the 28-d and 42-d tests, there should be two pore water measurements taken along the 28 day time course of the exposure period (still keeping with the recommendation of a 7-d equilibration period for the peepers).

Response: The BCSA Group has developed a pore water sampling program in Task 2C to support the assessment of the relative bioavailability of primary COPCs to benthic organisms. This approach will support the evaluation of potential relationships between multiple lines of evidence (i.e., laboratory-based sediment toxicity tests, benthic community composition, COPC concentrations in benthic tissues) and relative pore water COPC concentrations as observed across the range of field conditions in the BCSA as well as reference sites.

In addition, at the request of the USEPA and in consultation with the USEPA, toxicity test chamber pore water analysis will be conducted during the 28-day sediment toxicity test and focus on PCBs, trace total mercury, and TAL metal concentrations in samples collected using PDMS for PCBs and customized peepers for TAL metals and trace total mercury analysis. Pore water in a subset of samples will additionally be collected using DGTs and analyzed for trace total mercury and methyl mercury. Centrifuge will also be used to generate additional pore water samples for PCBs, mercury, methyl mercury and TAL metals, to the extent sufficient volumes of pore water can be obtained within the framework of the 28-day sediment toxicity test volumes. However, we note that measuring laboratory pore water concentrations is not a component of the standard toxicity testing method and is not likely to accurately replicate field conditions (i.e., ratio of meHg to total Hg in sediment) for several reasons, including disturbance resulting in complete loss of the natural sediment structure that existed in the field, exposure of the sediment to oxygen causing redox changes, temperature changes, and the introduction of particulates during sampling. For these reasons, field (i.e., *in situ)* pore water data are considered by the Group to be more relevant for evaluating potential effects *in-situ* than are laboratory-derived (i.e., *ex situ)* pore water data (Hansen *et al.,* 2005). Field pore water samples will also be collected at locations co-located with some of those sampled for the sediment toxicity test. Whole sediment, test chamber pore water, and field pore water COPC concentration data will be used to evaluate the existence and strength of concentration-response relationships.

21. Page 3-9, Section 3.2.1.2, Second Paragraph from the top of the page: The sequence of sampling events should be revised. Multiple grabs samples should be collected and homogenized to support the toxicity test and bulk chemistry analyses; however, a separate, discrete grab (not homogenized) should be collected to support the benthic community survey since the act of compositing/homogenizing will likely damage and impact the identification of the benthic organisms. Table 3-2 infers that benthic community samples will be composited with a sub-set of samples analyzed as discrete samples. Please clarify.

Response: Multiple grab samples were collected from each of the sampled locations to ensure sufficient material for toxicity testing, chemistry and benthic community assessment. With reference to the benthic community assessment, the approach taken in the field was to collect a known aliquot from each box core (or ponar, if the latter was used due to site access issues) for the benthic community samples. The aliquots were field sieved and the organisms that were retained on the sieves were composited on a per sample basis in the field containers with preservatives. The advantage of this approach is that (1) it ensures that the resulting data would be representative across all of the subsamples from each location, and (2) it avoids the potential damage to the benthic organisms from compositing the sediments since the post-sieved samples are combined in the sample bottle. The BSCA Group agrees with this assessment.

22. Page 3-9, Sec 3.2.1.2 Scope of Work and Investigative Methods: The group should increase the number of samples that will be selected for the 10- and 42-d tests. A minimum of 12 from BCSA and 4 from the reference areas should be included. Also, please clarify the path forward for selecting the 10-d and 42-d test samples.

Response: The Group will increase the number of samples for the 10-d and 42-d tests to 12 from the BCSA and four from the reference areas. See also response to comment #17.

23. Page 3-11, Section 3.2.3 Task 2C – Waterway Sediment Pore Water: The BCSA study as currently designed appears to consider the methyl mercury flux to be steady-state. However, methyl mercury flux from sediment to pore water varies seasonally and daily and was not found to be in steady-state (Gill et al., 1999), the flux varied over 3 orders of magnitude. Methyl mercury flux was found to be greatest during

the dark hours in Lavaca Bay, Texas and highest in late winter to early spring. Therefore, it may be useful to consider seasonal or diurnal effects.

Response: The Group agrees that pore water flux of methyl mercury (and other COPCs) is not likely to be a steady state process, and will vary seasonally and/or diurnally. However, this effect is likely to vary from location to location; in contrast to the Lavaca Bay findings of Gill et al (1999), studies in the Tagus estuary (Canario et al, 2007) found that methyl mercury fluxes were highest in the summer, and studies in the San Francisco Bay estuary found that the highest pore water methyl mercury concentrations were observed in the fall at some locations (Choe et al, 2004). The extent of variation is difficult to predict as it is likely dependent on a variety of site-specific biological and chemical factors. For example, Gill et al (1999) measured a diurnal range over three orders of magnitude, and Canario et al (2007) measured a seasonal difference of only 37%. Tidal cycling may also influence pore water flux (Ramalhosa, 2006).

However, the objective of the current sampling program is to collect sufficient data to evaluate pore water COPC concentrations over the range of sediment concentrations as one of several lines of evidence to provide insight on sediment toxicity and benthic invertebrate tissue residues. Sampling will capture the range of physical conditions and sediment COPC concentrations in the BCSA and reference sites under similar temporal conditions. As a result, it is anticipated that the pore water data collected from a subset of the same locations will provide some insight about the general range of COPC pore water concentrations, including methyl mercury. If analysis of the pore water data in the context of other lines of evidence indicates that a more detailed evaluation of pore water mercury dynamics is warranted, the need for seasonal and/or diurnal sampling will be evaluated during Phase 3b scoping.

24. <u>Page 3-11, Section 3.2.3 Task 2C – Waterway Sediment Pore Water</u>: The DQOs associated with the PCB analysis of pore water should explain why the analytical reporting limits of 0.02 to 2.79 ug/l are being used even though they may result in "non- detects" at concentrations that are greater than the New Jersey Surface Water Quality Standard of 64 pg/L.

Response: The water quality standard is not relevant in this case of pore water evaluation, as what is relevant is the ability to reliably detect PCBs in the pore waters of Berry's Creek. PCB detection frequencies in Phase 1 and Phase 2 surface water datasets varied among sampling events; however, the analytical methods achieved adequate sensitivity to identify areas of reoccurring elevated PCB concentrations and the effects of changing weather conditions. Detected surface water concentrations ranged from about 0.03 to 1 ng/L, and we expect pore water concentrations to be considerably higher in pore water. Additionally, PCB analytical sensitivity in sediment and biota was clearly adequate, as PCBs were detected in almost all Biologically Active Zone (BAZ) samples and all biota samples in Phase 1 and Phase 2. Therefore, the pore water analytical program is sufficient to characterize PCB presence and transport mechanisms in the BCSA.

25. <u>Page 3-13, Sec 3.2.3 Task 2C – Waterway Sediment Pore Water</u>: For mercury and methyl-mercury, the DGTs may provide useful data. However, these tools are still in their early phases of verification, and application by the scientific community. Therefore, another technique should be used to obtain and analyze pore water for mercury (e.g., in situ application of peepers?) Information from the Treatability Study work may alleviate the need for such other analysis. Please clarify the procedure for calculating pore water concentrations from the DGTs.

Response: As indicated in the Work Plan, the pore water sampling approach described for Task 2C was proposed pending the results of validation testing performed for the Treatability Study (TS)/Pilot Study (PS) work, with potential modifications to be proposed based upon the TS/PS findings. Preliminary results for passive mercury sampler testing for the TS have indicated that analytical sensitivity of typical commercially available DGTs for mercury and methyl mercury are not sufficient because low mercury concentrations were encountered in BCSA field pore water. While additional testing is being performed to improve DGT method sensitivity, for the purposes of the Phase 3a RI, the BCSA Group concurs that using the more proven approach of peeper sampling is appropriate for Phase 3a waterway work. A revised scope of work for Task 2C was provided to the USEPA in Amendment 1 to the Phase 3a Work Plan Addendum submitted in October 2012. The amendment discussed the use of DGTs, commercial peepers, custom peepers, and centrifuge to evaluate mercury and methyl mercury in pore water. At 11 locations each of these methods will be used to evaluate pore water concentrations and to evaluate which sampling method is best suited for use at the BCSA.

The DGT samplers sorb mass from the pore water. The mass that is sorbed is a function of the DGT sampler dimensions, the length of time the DGT was deployed, and diffusion coefficient of Mercury or Methyl Mercury. Upon receiving data describing how much mass is on each DGT sampler, these data are factored into a calculation based on Fick's 1st Law of Diffusion to estimate the pore water concentration surrounding the sampler.

26. Page 3-13, Task 2C, First Paragraph under bullet list: The work plan states that the passive sampler validation testing is currently being developed. Measurement performance criteria and the anticipated method for calibrating analytical instruments to quantify PCB compounds in the PDMS coated fibers should be provided. The work plan should also provide details or explanation on how the concentration in the PDMS coated fibers will be converted to units of pore water concentration.

Response: The extract from the PDMS samplers is analyzed using EPA Method 8082 which is the same method used for PCB analysis of all other aqueous samples. The measurement performance criteria and other QA/QC requirements for this method are described in the QAPP. No new measurement performance criteria or instrument calibration methods are required for analysis of the PDMS sampler.

PDMS samplers preferentially sorb mass from the pore water. The mass sorbed is a function of equilibrium achieved, the dimensions of the sampler, and the analyte. Upon receiving analytical data documenting the mass of PCBs in the sampler, these data are factored into a calculation to determine the pore water concentration surrounding the sampler. PDMS samplers will be deployed at 11 locations (one location in triplicate).

27. Page 3-14, Task 2C, Third and Fifth Paragraphs from the top of the page: The work plan states in the fifth paragraph on page 3-14 that a total of 45 passive pore water samples will be collected from Berry's Creek. The third paragraph on page 3-14 states that the goal is to deploy at least 8 of the planned 15 subtidal samplers. Clarify what the overall deployment goal is for the 45 passive samplers and the target deployment goal for the three reaches (MBC, BBC, and UBC).

Response: As noted in the response to comment #25, the Group is revising the scope of work for Task 2C and will provide further information to USEPA under separate cover.

28. Page 3-14, Task 2C, Sixth Paragraphs from the top of the page: The work plan states that 25 percent of the pore water sampling locations will be also marked for advective sampling. Clarify with a table or figure, which sampling locations will receive both passive and advective samplers. It is recommended that advective sampling occur in all three reaches (MBC, BBC, and UBC).

Response: As noted in the response to comment #25, the Group is revising the scope of work for Task 2C and will provide further information to USEPA under separate cover.

29. Page 3-14 to 3-15, Section 3.2.3.2, Scope of Work and Investigative Methods: The reference for methods on PushPoint sampling at the bottom of the page was not included in the reference section of the document. In addition, it was indicated on page 3-15 that only the dissolved mercury and methyl mercury fraction will be analyzed for the pore water collected from the PushPoint samplers. It was not clear if the filtration to obtain the dissolved portion will be performed in the field or in the laboratory. Please clarify.

Response: Filtration for the dissolved fraction will be completed by the laboratory. The complete citation for Riedel and Riedel, 2011 is as follows:

Reidel, G. and Reidel, F. 2011. Extraction of pore water from in situ sediments using Push Points. Prepared by the Smithsonian Environmental Research Center, Microbial Ecology Laboratory. Last updated May 2, 2011.

30. Page 3-17, Task 2D, Section 3.2.4.2.2 "Parameter Analysis": If sufficient tissue mass is not available and percent moisture and lipid analysis are removed from the parameter list, then what assumptions will be made during data interpretation to normalize the data?

Response: Percent moisture and lipid content data from all available benthic invertebrate tissue residue samples will be evaluated to determine whether substantive spatial variability is evident between sample locations, reaches in the BCSA (i.e., LBC, BCC, MBC, UBC), or between the BCSA and reference areas. If variability is not evident, then average values may be applied to normalize data where missing, if warranted. The uncertainty introduced by this assumption will be discussed in the report. Also note that sample collection for Task 2D has been completed and it is anticipated that sufficient biomass was obtained to complete lipid analysis at the majority of sample locations.

31. Page 3-26, Task 5A, Fourth Paragraph from the top of the page: The work plan states that waterway BAZ samples will be co-located with benthic toxicity testing; however, based on a comparison of Figure 3-3 and Figure 3-6, the "mercury dynamic and bioavailability" samples are disproportionately co-located. For example, there are three proposed mercury samples in Toxicity Testing Area No. 13 on Berry's Creek Canal but no mercury samples in Toxicity Testing Area No. 14 also located on the canal. Meanwhile, there is one proposed mercury sample in Toxicity Testing Area No. 11 in Middle Berry's Creek but no mercury samples in Toxicity

Testing Area No. 12. Please clarify rationale for uneven sampling distribution.

Response: In addition to co-location with toxicity test sample locations, sample locations for Task 5A were selected to capture the range of mercury concentrations and physical conditions (e.g. sediment texture, salinity, geochemical conditions) that would be predicted to affect mercury speciation. For example, samples are proposed from Toxicity Testing Area 13 in BCC (Medium-low potential dose) but not from Toxicity Testing Area No. 14 (Low potential dose) as noted. However, samples are proposed from Toxicity Testing Area No. 15 in LBC (Low potential dose), which represents a similar range of salinity as Areas 13 and 14 but lower potential mercury concentrations and a somewhat different geochemical environment than Area 13. Other sample locations have similarly been placed throughout the study area to capture the predicted range of mercury concentrations and geochemical conditions relevant to mercury speciation.

32. Page 3-26, Task 5A, Fourth Paragraph from the top of the page: Please explain why AVS-SEM is not included in the analytical work. AVS-SEM analysis on bulk sediment would complement the direct measurements on sulfate and sulfide.

Response: AVS-SEM was not explicitly listed in this referenced section because the Task 5A samples are collected at the same locations as the Task 2A (sediment toxicity) samples, which include AVS-SEM analysis at all locations. Therefore, AVS-SEM data (Task 2) and sulfate and sulfide measurements (Task 5A) will be available at each Task 5A location and will be considered during analysis of Task 5A results.

33. Page 3-27, Task 5B, Second Paragraph from the top of the page: It is assumed that the Phase 2 Report provides support to the conclusions that the highest level of mercury methylation in marsh sediments is occurring between 10 and 25 cm. What is the significance of the marsh sediment cores being discontinuous with respect to this conclusion?

Response: As noted, the conclusion that the highest mercury methylation occurs between 10 to 25 cm is based on low resolution marsh cores collected in Phase 1 and Phase 2, as well as high resolution methylation/demethylation cores. The data are presented and discussed in the Phase 2 Report (Appendix G generally discusses high resolution cores; Appendix G, Section 1.2.2 discusses the low resolution coring activities and findings from the Phase 1 report; Section 2.3.4.3 discusses marsh concentration trends).

The Group does not understand the question related to core discontinuity. As proposed in the Phase 3a Work Plan, the samples would be collected from two depths representative of differing redox conditions: 10-15 cm (typically increment of highest MeHg concentrations) and 35-50 cm (typically increment of lowest MeHg concentrations). However, the Group revised these sampling increments to 0-5 cm and 15-20 cm, as communicated to USEPA during the field work. These increments will still provide a strong contrast in mercury concentrations and redox conditions, as well as be more useful in developing exposure point considerations.

34. Page 3-27, Task 5B, Third Paragraph from the top of the page: Please clarify why Oritani Marsh and Paterson Plank Marsh will not be sampled for "Mercury Dynamics and Bioavailability" (Task 5B).

Response: The objective of this task is to develop an understanding of how partitioning of mercury changes across the range of conditions present in the BCSA. Data collected to date has identified the range of mercury across marshes, therefore sampling of every marsh is not required to sample across the range of values. The rationale for not sampling the two marshes in question is as follows.

Paterson Plank Marsh: No sampling is proposed in Paterson Plank Marsh due to a fire that occurred in this area in the spring of 2012, in which almost the entire marsh burned to the ground. The short term effects of the fire on COPC concentrations and marsh geochemistry have not been measured, but the post-fire conditions are not considered representative of typical conditions. Therefore, sampling was proposed in other marshes. At a minimum, the surface litter layer has been destroyed and organic matter content in surface sediments may or may not be different from other marshes temporarily due to combustion of the above ground organic materials. Devegetation of marsh sediments has also been shown to decrease mercury methylation rates (Windham et al, 2009). Additionally, potential effects of the fire on the marsh microbial and invertebrate communities are unknown. In place of Paterson Plank Marsh, nearby Eight-Day Swamp will be used.

Oritani Marsh: Oritani Marsh and Tollgate Marsh, which is also located along BCC, have similar mercury concentrations in surface sediments. Phase 1 and Phase 2 data have demonstrated that the mercury concentrations are lower and the hydrology in Oritani Marsh is altered compared to other marshes in the BCSA, due to disposal of dredge spoils from the construction of BCC in the early 1900's. Oritani Marsh also has limited connectivity to BCC. As a result, sampling is proposed in Tollgate Marsh instead of Oritani

Marsh.

35. Page 3-31, Task 7: Figures for Task 7 should be labeled Figures 3-8a through Figure 3-8c, not Figure 3-7.

Response: We agree the figure numbers should have been changed. However, regarding revisions to the Phase 3a Work Plan Addendum, and consistent with feedback from the USEPA RPM, no revised Phase 3a Work Plan will be submitted.

36. Page 3-33, Task 7, Paragraph beneath bullets: Please clarify how the RI/FS will estimate the inventory of contamination in the marshes given that there is only limited data with respect to the 5-10 cm interval. While recognizing the original rationale (the 0-5 cm interval represented surface exposure-point concentrations and the 10-15 cm interval represented higher, historical concentrations at depth) we do not want to complete Phase 3 sampling only to realize that we are missing important information relating to that sediment horizon. Please re-evaluate this with respect to development of the Phase 3b Work Plan.

Response: Marsh samples have been collected from the 0-5 cm and 10-15 cm increments at 78 locations, in accordance with the Phase 1 and Phase 2 Work Plans. Sediment samples were also collected from an additional 24 marsh locations in 2 cm increments from 0-16 cm as part of the mercury methylation/ demethylation task in Phase 2, so data from three sample increments fall within the 5-10 cm range from those locations (4-6, 6-8, and 8-10 cm). In addition, samples collected from 14 marsh locations in Ackerman's Marsh as part of the UOP remedial investigation provide additional data spanning the 0-15 cm depth. All of the data collected in the marshes to date support a conclusion that peak concentrations typically occur in the 10-25 cm depth range, and the data available from the 5-10 cm increment support this conclusion. Section IX.A.2 of the Statement of Work (Appendix B of the AOC) requires the Group to "identify areas or volumes of media to which general response actions may apply…." The Group is confident that adequate data will be available to complete the analysis required by the SOW.

37. Page 3-35, Section 3.8.2, Data Validation: The section's last paragraph indicated that for non-EPC data, 75% of the Phase 3 data will undergo validation screening by an automated quality system. Please provide additional information of what are the validation criteria that will be used as part of the automated system of validation.

Response: The automated quality system referenced in the comment will not be used.

The primary analytical laboratory, TestAmerica, implemented a new Laboratory Information Management System (LIMS) during Phase 2. Several data reporting issues that related to glitches in the lab's new LIMS were identified and corrected during Phase 2 data validation. To ensure that similar data reporting issues continue to be caught during Phase 3a, the Group has decided to continue with customized tier II validation for 100% of the project data. This is the same approach and level of validation implemented in Phase 2.

QAPP Comments:

38. Phase 3a QAPP Addendum and Cross Reference, page 1of 86: The cross reference provided for Worksheet #17 is the 2009 QAPP. However, the current proposed sampling tasks were developed after the Phase 1 and 2 were completed. Therefore, this worksheet should be updated to include the rationale for the proposed Phase 3a activities.

Response: Comment noted. An updated version of Worksheet #17 that includes the rationale for Phase 3 activities will be included in the Phase 3b QAPP submission. The rationale for the Phase 3a activities are described in the Phase 3a Work Plan Addendum.

39. QAPP Worksheet #3 Distribution List, page 3 of 86: Please update the phone number for William Sy to (732) 321-6648.

Response: Comment noted. Contact information for William Sy will be updated in the next QAPP submission.

40. QAPP Worksheet #5 Project Organization Chart, page 11 of 86: Similar to above, the phone number for William Sy should be updated. In addition, the zip code indicated is in error and it should be changed to 08837.

Response: Comment noted. Contact information for William Sy will be updated in the next QAPP submission.

41. QAPP Worksheet #12 Measurement Performance Criteria Table, page 25 of 86: The worksheet indicated that ICB, CCB and low level standard (CRI) as part of the QC samples to be performed. The submitted laboratory SOP did not include this information. In addition, the measurement performance criterion for CRI is that the average result should be ±50% of expected value. There was no information

on how the average will be determined. The worksheet also did not include LCS and MS/MSD samples which were part of the submitted SOP. Please clarify if these samples will be analyzed and include them with the worksheets, if required. In addition, the submitted laboratory SOP should be modified to reflect any project specific requirements.

Response: The worksheet was prepared and submitted by Applied Speciation so although the SOP does not reflect the inclusion of the ICB, CCB, and CRI, these QC samples are analyzed by the laboratory during arsenic speciation analysis. The lab will be asked to either modify the SOP to indicate this or asked to supply an addendum sheet indicating their inclusion in the analytical run. Section 9.8 of the SOP submitted by Applied Speciation indicates that LCS, Matrix spike, and laboratory duplicate samples will be included in the analytical sequence. Applied Speciation will be asked to add these QC samples to WS#12 with the applicable acceptance criteria.
The CRI standard is implemented during the ICP/MS portion of the analysis. The "average" result is the average of the results from the multiple exposures of the CRI on the instrument. Applied Speciation will be asked to document this calculation in the SOP or in an SOP addendum.

42. <u>QAPP Worksheet #19 Analytical SOP Requirements, page 55 of 86:</u> For this worksheet, please include not only "new" analytical SOPs but also previous SOPs from the completed work that applies to this phase of the project. In addition, the referenced SOP ASC-3110.1 for arsenic speciation was not included with the submitted laboratory SOPs.

Response: Worksheet #19 from previous QAPP submissions (Phase 1 and Phase 2) includes information regarding previous SOPs submitted for the project. For ease of reference, these worksheets, as well as all of the referenced SOPs, are provided on the enclosed CD. The requested SOP for sample extraction for arsenic speciation is also included on the CD.

43. <u>QAPP Worksheet #20 Field Quality Control Sample Summary Table, page 58 of 86</u>: The worksheet is missing the field duplicate information outlined in Task 5A of Worksheet #18.

Response: One field duplicate will be collected for Task 5A to assess sampling error/variability, as noted in Worksheet #18. An updated version of Worksheet #20 will be included in the Phase 3b QAPP submittal.

44. QAPP Worksheet #23 Analytical SOP References, page 63 of 86: The worksheet indicated that the SOP for Selective Sequential Extraction of Samples for Determination of Biogeochemically Relevant Inorganic Mercury Fractionation as providing definitive data. Previous information indicated that this is a semi-quantitative method. Data from a semi-quantitative method should be considered more of a screening level type data than definitive data. Please revise the worksheet.

Response: Comment noted. As described in the Data Quality Objective for Task 5, the sequential extraction analysis provides semi-quantitative data, which will be evaluated and interpreted as one of several lines of evidence related to mercury bioavailability. An updated version of Worksheet #23 will be included in the Phase 3b QAPP submission.

45. QAPP Worksheet #30 Analytical Services, page 86 of 86: Similar to comment No. 42, above, all applicable information for this phase of the work should be included in the worksheet.

Response: Worksheet #30 from previous QAPP submissions (Phase 1 and Phase 2) included information regarding previous SOPs submitted for the project. For ease of reference, these worksheets, as well as all of the referenced SOPs, are provided on the enclosed CD.

46. FSP Section 3.4, Task 2C-Waterway Pore water, page 3-6: It was indicated at the bottom of the page that if the Group is unable to deploy the samplers in at least eight subtidal locations out of the fifteen planned, EPA would be contacted. Does the completion of at least eight subtidal locations account for where in the BCSA they are located?

Response: As noted in the response to comment #25, the Group is revising the scope of work for Task 2C, including the waterway pore water and will address this comment in a separate submittal to the USEPA.

47. The table of contents for Appendix C is missing SOP 3.9 Extraction of Pore water from In Situ Sediment using Push Points.

Response: Comment noted. The table of contents for Appendix C will be updated in the next QAPP submission.

48. SOP 4.6 Marsh Sediment Specific Yield Evaluation – It would be helpful if the nomenclature (W_1, W_2, etc.) used in the Test Form is also provided with the step by step procedure in the SOP.

Response: Comment noted. The SOP will be updated to identify the referenced nomenclature in the next QAPP submission. Abbreviations used in the form are defined as follows:

Abbreviation	Definition
W1	Ring tare weight
W2	Initial core weight
W3	Initial sediment weight (W2-W1)
W4	Weight of transfer container
W5	Weight of saturated core + transfer container
W6	Weight of saturated sediment (W5-W1-W4-W9)
W7	Weight of water after re-saturation (W6-W3)
W8	Final core weight
W9	Cloth + tape weight
W10	Final sediment weight (W8-W1-W9)

49. The laboratory SOPs detailing the handling of the preparation and extraction of the passive samplers should be provided.

Response: The passive (PDMS) samplers are extracted in hexane with a subsequent acid cleanup step. The laboratory SOP (ID number) has been amended to reflect this procedure and is included on the enclosed CD. The extract is analyzed using USEPA method 8082, as discussed in response to comment #26.

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July 15, 2013

-- Via E-Mail and Regular Mail --

Douglas J. Tomchuk, Remedial Project Manager
United States Environmental Protection Agency
Region 2, 290 Broadway
New York, NY 10007-1866

RE: Berry's Creek Study Area
Response to Comments on the Phase 3b Work Plan and QAPP Addenda

Dear Mr. Tomchuk:

In response to your July 10, 2013 letter regarding comments on the Phase 3b Work Plan Addendum, the BCSA Group offers the following responses:

The United States Environmental Protection Agency's (USEPA) comments are presented below, followed by The ELM Group, Inc.'s responses in *italics.*

1. For fiddler crab NOAA recommends separate analysis of males and females of the same species and size range. If tissue mass is insufficient, fiddler crab composites should consist of an equal number of similar-sized adult males and females of the same species. Information about sex/gender/size of organisms for each sample analyzed should be provided.

   Response: The sex, size and species of each crab within each composite sample is recorded as part of our standard operating procedure and that information will be provided as part of the data packages provided to the Agencies. Crabs within the same size range are selected for analysis. We do not, however, propose to analyze for COPCs separately in each sex and species of fiddler crab in the BCSA. As stated in the Work Plan and the QAPP, the data quality objectives for the fiddler crab sampling are to collect additional COPC tissue data to supplement previously collected data and to support risk assessment in avian predators. Previous sampling efforts did not segregate samples by sex or species with the rationale that avian predators are likely to prey on all fiddler crabs that are present, and therefore, a composite sample across sex and species will provide a representative sample of what could be present in the diet of an avian predator. The Group maintains that sex and species specific analysis is

not needed to meet this objective. In addition, the Group recognizes the value and importance of maintaining comparability of Phase 3B data with previously collected data, and therefore, we recommend that sampling procedures and approach not be changed in Phase 3b.

2. Sex, length, and weight data for white perch should be included for all sampling to be able to interpret contaminant concentrations related to fish age. For composite samples, the sex/length/weight data should be reported for all individuals in the composite.

   Response: As part of the SOP, the length and weight data are recorded for each fish within each composite sample and these data are used to support the analysis of COPC residue data in white perch. These data will be provided to the Agencies as part of the overall tissue residue data package. We do not record sex, however, and all previously collected white perch data are composites across sex. The rationale for this approach is the same as stated above for the fiddler crab – namely that avian predators (or human anglers) are likely to capture fish across both sexes and therefore a composite sample across sex will provide a representative sample with which to assess potential dietary exposures and risks. As above, the Group maintains that sex-specific COPC analysis is not needed to meet risk assessment objectives. Further, also as above, we maintain that it is important to keep consistency in sampling methods across phases to support data analysis. As an aside, there are practical considerations related to determining the sex of BCSA field collected white perch. White perch in the BCSA are generally smaller fish in the range of 150-190 mm. Sexual dimorphism in perch is dependent on maturation and fish in the BCSA size range are not sufficiently developed to permit consistent and reliable determination of sex based on external examination; internal examination of the gonads would be needed. The Group maintains that this level of investigation is not needed to meet data quality objectives.

3. QAPP Worksheet #12 -It is not clear why field duplicate samples were not included for the dioxin/furan and PCB congener analysis of the tissue samples. Please explain.

   Response**: Field duplicates are not performed on tissue samples since they are composites of many organisms combined to provide sufficient mass of sample for analytical extraction. Since homogenization is not performed in the field, it is not possible to collect a true field duplicate, for which homogenization occurs in the field. Note that the analytical program does explore the reproducibility of analytical results through Lab Control Sample/ Lab Control Sample Duplicate and Matrix Spike/ Matrix Spike Duplicate analyses, where applicable per the method.**

4. The QAPP addendum is missing QAPP Worksheet #15 for the dioxin/furan analysis of the tissue matrix.

   ***Response*: The dioxin/furan material for QAPP Worksheet #15 is provided as an attachment.**

5. QAPP Worksheet #18- Tasks 11, 12 and 14 included field parameters with an asterisk under the analytical group column. The footnotes provided in the worksheet did not include the asterisk information to indicate what these field parameters are.

   ***Response*: Field parameters are listed as the last line of the Notes at the end of the Worksheet.**

6. QAPP Worksheet #28- The laboratory name is missing for the worksheet involving the POC analysis.

   ***Response*: Assuming that the comment refers to Worksheet #28 Page 13 of 24, the laboratory name (TestAmerica Pittsburgh) is indicated at the top of the table.**

Please contact me if you have any questions regarding this submittal.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock

Peter P. Brussock, Ph.D.
Project Coordinator

c: John Hanson, Esq.

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August 16, 2013

-- Via E-Mail --

Douglas J. Tomchuk, Remedial Project Manager
United States Environmental Protection Agency
Region 2, 290 Broadway
New York, NY 10007-1866

Re: Berry's Creek Study Area
Phase 3b Work Plan/QAPP Addendum- Oversight

Dear Mr. Tomchuk:

In response to your July 18, 2013 letter regarding additional comments received on the Phase 3b Work Plan/QAPP, we offer the following responses:

1. <u>Work Plan, Section 2.2.2.2 "Task 9B," Page 2-3, Last Paragraph on Page</u>: Please clarify that surface sediment samples will be collected from "sand-only" Pilot Study plots to characterize recently deposited material.

Response: *The comment is correct, surface sediment samples will only be collected from "sand-only" Pilot Study plots.*

2. <u>Work Plan. Section 2.2.2.2 "Task 9B," Page 2-3, Last Paragraph on Page</u>: Work Plan states that deposited solids will be separated from the placed sand by processing on a 200 sieve by the laboratory (which is expected to remove 86 percent of the sand plot material). Please consider the addition of grain size analysis for these samples, similar to other surface sediment samples.

Response: *Collection of samples for grain size analysis is not proposed at this time. The grain size distribution of the placed material is known from the Pilot Study work, and sieving will provide separation of the fine-grained material for analysis. In addition, a large sample volume is required for grain size analysis, and the BCSA Group is attempting to minimize disturbance of the Pilot Study plots.*

3. <u>Work Plan, Section 2.3 "Task 10," Page 2-5 and Table 2-2</u>: Please provide a table listing which sampling locations will receive the full suite of chemical parameters and rationale.

Response: *The enclosed table identifies sample locations where full-suite analysis will be completed.*

4. <u>Field Sampling Plan, Section 3.2.2, Page 3-3, Third sentence</u>: The FSP states that "At all waterway sediment sampling locations, sufficient cores will be collected to meet sample volume requirements; the number of cores will be a function of recovery and moisture content and will be minimized to the extent possible." Please clarify the criteria that will be used for core recovery and moisture content to ensure sufficient sediment volume is collected.

Response: *Core recovery is measured and moisture content is visually assessed at the time of core collection. If low recovery (i.e., less than approximately 80% recovery) or high moisture content (i.e., very wet/liquid sediments) are observed, an additional core will be collected from the same sample location to ensure that adequate mass is available to meet laboratory sample mass requirements.*

5. <u>Field Sampling Plan, Section 3.3.3, Page 3-5 and 3-6, General Comment</u>: It is recognized that marsh invertebrate sample collection is difficult and that tissue mass is limited. For samples that require gross compositing due to limited mass (refer to bottom of page 3-6) it would be helpful to provide a table of the number and type of taxa include in the composite and the relative tissue mass per taxa to better characterize the composite tissue sample.

Response: *The BCSA Group is not proposing to collect mixed invertebrate samples in Phase 3b. However, the number of individuals per species of spiders in each composite will be recorded. It is not feasible to complete field identification of amphipods, and the BCSA Group does not expect to encounter more than one species of earthworm.*

<u>6.</u> <u>Field Sampling Plan, Section 5.1, Page 5-l, Second sentence in first paragraph:</u> The FSP text should provide the criteria for "major storm events," which is defined in the Work Plan as "...(forecasts of 2:2.0 inches of precipitation)."

Response: *Based on observations of the response of streams in the study area to precipitation events, there is a substantial increase in the runoff volume and potential sediment transport that occurs with precipitation events greater than 2 inches.*

7. <u>SOP #1.5, Page 5, Section 2.4, Third Paragraph</u>: Please clarify if water depth and velocity measurements at drainage locations will be recorded across the transect. Also, please clarify if velocity measurements will be recorded at multiple depths (e.g., 0.2 and 0.8 times the total water depth) for deep water (greater than 2.5 feet).

Response: *The referenced paragraph will be revised as follows:*

At all drainage locations, the depth of water will be recorded and a hand held current meter used to record the velocity. These parameters will be measured at a minimum of 3 locations across the channel transect, including at the location of the piling. The velocity will be measured at a height above the sediment bed equivalent to 0.6 times the total depth at each location. In addition, the velocity will be recorded at the piling at the depth corresponding to the fixed depth of the continuous velocity probe. Under conditions where the total water depth is greater than or equal to 2.5 feet, velocity measurements will also be measured at a height above the sediment bed equivalent to 0.2 times and 0.8 times the total depth, if feasible. Past site experience has shown that these water depths typically only occur during storm flow conditions when the channel water depth and flow rates may be changing rapidly. Therefore, velocity measurements at depths of 0.2 times and 0.8 times the total depth will only be recorded if, in the field team's judgment, all of the velocity measurements can be recorded across the transect under the same general flow condition. If the channel water depth and flow are changing too rapidly to meet this criterion, the velocity measurements will be limited to 0.6 times the total water depth at each transect location. In the event that the channel cannot be safely accessed, the flow velocity will be estimated by timing the rate of movement of a float (e.g., a tennis ball) on the water surface.

8. SOP #2.2. Page 5, Section 2.2. Second Bullet: The SOP discusses collection of samples within 1 meter of the water surface by direct submersion of an intermediate sample container, which would then be used to fill the smaller preserved sample containers. However, the bullet states "Filtered samples would require the use of a peristaltic pump and filter, the sample would be immediately drawn from the intermediate bottle. The intermediate bottle should be continuously swirled to avoid settling of solids." Please consider pumping directly from the water body into the bottle with an in-line filter instead of using an intermediate container as this protocol will ensure there is no possibility of loss of solids in the intermediate container.

Response: *The approach described in SOP #2.2 has been used for surface water sample collection since Phase 1. In order to maintain consistency with previous sampling efforts, no change in sampling method is proposed at this time.*

9. QAPP Worksheet 20, Surface Water, "POC": POC sampling should include an equipment blank and a filter blank. These quality control samples need to be included in the data validation so that negation due to measurable blank contamination can be addressed.

Response: *The Group will include an equipment blank for POC samples. However, no sample filtration is required for the selected analytical method, so a filter blank is not warranted.*

Phase 3 Data Interpretation Concerns

10. Work Plan, Section 2.2.2.2 "Task 9B." Page 2-3, Last Paragraph on Page: Please describe how the Task 9B methylmercury concentrations will be interpreted since these samples will include a large sand fraction (since they will have been analyzed prior to removal of the Pilot Study placed sand).

Response: *The BCSA Group anticipates that recently deposited material will be readily distinguished from the material placed for Pilot Study construction due to differences in color and texture. The intent of this task is to only sample the deposited material, to the extent practicable, so a large sand fraction is not anticipated. The methyl mercury results from recently deposited material will be used to complete a preliminary evaluation of how concentrations in recently deposited materials compare to overall BAZ methyl mercury concentrations in mudflat sediments.*

11. Work Plan, Section 2.3.1.1 "Task 10," Page 2-5 and Figure 2-3: As discussed during the March 2013 meeting, it may be more appropriate to revise the Thiessen Polygons to respect the internal waterways on the marshes. As currently, presented the polygons abruptly cross over marsh tributaries because ArcGIS is following a program to find the mid-point between sampling locations. It may be beneficial to use professional judgment on the polygons and adjust where needed to respect natural features in the marshes.

Response: *Comment noted. Future analyses using Thiessen Polygons will not be extrapolated across major marsh tributaries.*

Please contact me if you have any questions regarding this submittal.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

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July 3, 2014

-- Via E-Mail and U.S. Mail --

Mr. Douglas Tomchuk
USEPA Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: Berry's Creek Study Area (BCSA) – Response to Comments on Phase 3b-2014 Work Plan Addendum and Modeling Plan Addendum; and Conditional Approval for Phase 3b-2014 Addendum QAPP/FSP for the Surface Water Organic Matter and COPCs Assessment Using Optically-Based Methods

Dear Mr. Tomchuk:

The BCSA Group has reviewed the comments provided with the June 4, 2014 Phase 3b-2014 Work Plan Addendum and Modeling Plan Addendum letter and the June 10, 2014 Conditional Approval for the Phase 3b-2014 Addendum QAPP/FSP. Responses to all comments relating to above referenced Phase 3b-2014 documents are provided herein. In a few cases, comments on the modeling work cannot be fully addressed at this time, but we plan to continue the productive dialogue between the Group's modeling team and USEPA's reviewers to ensure opportunities for comments and discussion occur regularly as the modeling work progresses. In addition, enclosed are the revised Work Plan and Modeling Addenda, consistent with the responses to comments.

If you have any questions related to these responses, please feel free to contact me. Any other comments that may be provided by the USEPA on these deliverables will be addressed in a separate response.

Sincerely,
THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

Attachment

c: John Hanson, Esq.

ATTACHMENT
Berry's Creek Study Area
Responses to USEPA Comments re: Phase 3b WP Addendum, Modeling Plan Addendum and Conditional Approval (QAPP/FSP Addendum)
July 3, 2014

Each of the USEPA comments and are identified below and are followed by a response in italics.

Ph3b - 2014 Work Plan Addendum

1. Table 2-3: Please confirm the number of ADV deployments in Table 2-3. For example, the first bullet under "Waterway Study" indicates that an ADV will be deployed at MHS-05 and MHS-06 (this statement is likely an error according to page 2-19 of the Work Plan). The third bullet states correctly that an ADV would be deployed at MHS-07.

   Response: Table 2-3 and the text are correct. ADCPs will be deployed at stations MHS-01. MHS-05, and MHS-06 to measure water velocity. An ADV will be deployed at station MHS-07 to record velocity due to the low depth of water at this station. Stations MHS-05 and MHS-06 will also be equipped with a near bed instrument package consisting of an ADV and a LISST to record high frequency measurements of acoustic backscatter (ABS) and velocity near the sediment bed to provide a detailed assessment of sediment resuspension dynamics. Table 2-3 has been modified to clarify this.

2. Table 2-3: ORP and conductivity are listed in Table 2-3 as measured parameters, but they are not listed on page 2-19 of the Work Plan. Conversely, the Work Plan lists chlorophyll, colored DOM, and optical backscatter as parameters for Task No. 17. Please include these parameters in Table 2-3 and check table for internal consistency.

   Response: Table 2-3 has been modified to remove ORP and to add chlorophyll, CDOM, and optical and acoustic backscatter. The YSI multi-probe measures both salinity and conductivity. The work plan text and Table 2-3 have been modified to reflect this.

3. General Comment on Figures: During previous presentations, the PRP Group has provided a photograph of the optical package with the various instruments labeled. It may benefit the Work Plan description if a similar photograph was included in the Work Plan and referenced when discussing the various components and instruments of the "full" and "reduced" optical packages.

   Response: Figure added as requested.

4. Page 2-17, Section 2.4.1 (last paragraph): The Work Plan provides a reference to a United States Geological Survey article (Bergamaschi et al., 2011) where optical measurements were used to measure mercury and methylmercury. Please clarify if the methods proposed under Task No. 17 are consistent with the reference method, or if site-specific deviations were required (if so, please describe the deviations).

Response: The methods to be used under Task No. 17 are consistent with the approach used by Bergamaschi et al. (2011) and will use the same types of instrumentation and apply the same underlying principles to develop the optical models. Modifications to the specific methods, such as depth and frequency of monitoring, have been made to address site specific conditions and study objectives. In addition, Task No. 17 incorporates ancillary analyses (e.g., near bed monitoring) that will supplement the interpretation of the optical model predictions.

5. Page 2-18, Section 2.4.2 (first paragraph) and Table 2-3: Task No. 17 rationale as stated in Table 2-3 includes the use of optics to "evaluate the relationship of water column COPCs to uptake by biota." This rationale or study objective is not stated in Section 2.4.2 of the Work Plan. Please check for consistency.

   Response: This rationale is provided in final paragraph of Section 2.4.1 on page 2-18 of the Work Plan Addendum, as follows: "[The optically-based predicted COPC] data will support the calculation of long-term (e.g., 28-day) average and related statistics for water column COPC concentrations for each reach of the system, which are more representative of water column COPC exposures and uptake than single point-in-time measurements. These long-term statistics will be evaluated with COPC concentrations in biota tissue samples collected in the following month under Task 16 and baseline monitoring to assess the relationship between water column COPCs and uptake by biota."

6. Page 2-19, Footnote 9: Please clarify the rationale for moving the optical instruments to an alternative location for the calibration and validation sampling.

   Response: Because the BCSA is a Phragmites marsh-dominated, tidal system across its length, the relationships between the various optical parameters (e.g., chlorophyll, CDOM, backscatter) and the biogeochemical parameters (e.g., POC, DOC, COPCs) will be characteristic of the system as a whole. Although these relationships potentially may vary seasonally, they are unlikely to vary substantially within the planned monitoring period for Task No. 17. As a result, calibration at a given location that covers the range of conditions across a spring tidal cycle will support the development of optical models that can be applied to measurements at any point in the system.
   We have reviewed the scope of work proposed for Task No. 17 in light of EPA's comment. Based on this review, we have added validation sampling at the two marsh tributary locations as part of the waterway-marsh exchange program. This sampling will support an evaluation of the model accuracy within the marshes, where upland inputs are insignificant and where organic loadings are higher than in the waterways.

7. Page 2-20, Section 2.4.2.2 (first paragraph) and Figure 2-7: Please provide rationale

for the selection of the two tributary locations for water-marsh exchange (i.e., why were these locations chosen; are there known data gaps in Eight Day Swamp and Walden Swamp).

Response: The marsh sampling locations were selected to monitor marsh exchange in a relatively isolated marsh tributary that is not influenced by upland discharges and that serves as the primary conduit for tidal exchange to a discrete area of marsh. By reducing the number of variables, this approach supports an evaluation of exchange of organic matter (POC, DOC), suspended solids, and COPCs resulting from tidal interaction with the marsh. In addition, the areas selected are regarded as representative of UBC and MBC conditions, which will provide a measure of how conditions differ between two locations.

8. COPC analysis for Mud crab and Grass shrimp should include total mercury. Unlike for fish, there is no way to estimate total mercury from just the methyl mercury concentrations for crab and shrimp. Total mercury is planned for Fiddler crab, so it would be impossible to compare mercury concentrations for the different benthic organisms without having total mercury (in addition to methylmercury) for all benthic species.

   Response: The Work Plan has been modified to include total mercury analyses for grass shrimp and mud crab tissues.

9. For larger (>200 mm) white perch collections, the preference should be to collect the largest specimens, preferably greater than 230-240 mm, if available. Sex of each individual fish needs to be recorded, and if possible, equal numbers of male and female fish should be collected from each area. Recommend target collection and analysis (individual fish) of large white perch from 4 BCSA subareas (5 for each sex from UBC, MBC, LBC, and BCC).

   Response: The intent of this proposed work is to collect the largest perch for chemical analysis. The Work Plan has been modified to explicitly state that the largest white perch collected will be selected for chemical analysis. To our knowledge, the sex of white perch cannot be determined based on external examination, and therefore the sex of the collected specimens will not be recorded. The Group will consider adding sex determination to the perch sample collection if EPA provides the recommended approach for determining white perch sex in the field.

10. The Berry's Creek Group has not yet provided EPA with information comparing the total PCB concentration as measured by PCB Aroclor methods and PCB congener methods for the 2013 biota sampling. Please provide such information in the near future.

Without such information in hand, it would seem prudent to conduct PCB congener analysis for 25% of the samples being analyzed for PCBs as part of the larger white perch collection.

Response: The BCSA Group provided to the USEPA (January 10, 2014 meeting presentation with USEPA) a preliminary analysis of the comparison of the total PCB concentration as measured by PCB Aroclor methods and PCB congener methods for the 2013 white perch sampling data. A more complete comparative analysis will be provided to the USEPA once the full data set has been validated. In the meantime, to augment the available 2013 data set, the Group will add PCB congener analysis of fish tissue (white perch whole body and fillet, mummichog whole body) to the summer 2014 sampling program. We propose to analyze mummichog and white perch in 3 samples per reach in the BCSA (30% of samples) and in each of the Bellman's Creek and Mill Creek reference sites. This sampling will provide additional data with which to compare our 2013 congener data in fish. The Group will not sample blue crab for congeners in 2014 as all data collected to date, including the 2014 congener data, demonstrate much lower PCB concentrations in crab compared to fish. Additionally the Group will analyze for PCBs congeners (as well as MeHg and selenium) for up to three of the larger white perch (as requested above) collected in UBC or MBC and the reference sites. The location of these larger perch samples will be dependent upon where they are found in UBC and MBC, where COPC concentrations are generally higher.

11. <u>Section 2.4.2.1, Page 2-19:</u> Please clarify the location of the optical instrumentation from MHS-01 and MHS-07 during the calibration and validation sampling relative to MHS-05 and MHS-06. Are they co-located in the same pilings or will they be deployed within a certain radius of MHS-05 and MHS-06?

    Response: The instrumentation will be co-located on the same piling and situated such that the optical measurements are taken from as close as practical to the location from which the samples are collected for calibration/validation.

Modeling Plan Addendum

General Response: Several of the comments to the Modeling Plan Addendum relate to the specifics of the approach to sediment transport modeling. In many cases, there are multiple approaches that may be applied and the most appropriate approach must be evaluated based on a detailed analysis of the available data and model performance. As was discussed during the May 11, 2014 meeting with the Agency *modeling team, the BCSA Group is committed to routinely update the Agency modeling team on the model development progress and to review decisions on the modeling approach. The Modeling Plan Addendum has been modified to specifically identify regular updates (e.g. meetings or webinars) will be a part of the modeling process.*

12. Sec. 5.1.3, last bullet, pg 5-5: Please clarify the last sentence, specifically how the thickness of sediment accumulated will be calculated based on measured profiles of sediment density. This needs to be explained, including defining when this will be calculated (i.e., as necessary), and how profiles of sediment bulk density will be measured (and the associated uncertainty in this measurement).

    Response: The sentence has been clarified. The model will be used to calculate the transport of sediment mass in terms of flux to and from the sediment bed, and the quantity of sediment mass accumulated in a model grid cell. A representative bulk density is then used to determine the equivalent thickness of this accumulated mass. The representative bulk density for regions in the model will be determined from dry bulk densities measured in site sediments as part of the RI. The exact procedure for this and the determination of uncertainty will be part of the sediment transport modeling work and will be reviewed with the Agency reviewers at meetings, webinars, and/or teleconferences.

13. Sec. 5.1.4, last paragraph, pg 5-6: Will quantified metrics be used to determine when the "model uncertainty in any area is found to be inacceptable"? If so, which metrics will be used?

    Response: Quantitative and qualitative metrics will be used to determine when uncertainty is unacceptable. The primary quantitative metrics are anticipated to be measured TSS and sediment accumulation; however, as mentioned in Section 4.2, determination of appropriate model metrics will be part of the modeling work and will be reviewed with the Agency modeling team through meetings, webinars, and/or teleconferences.

14. Sec. 5.2.l, 1st paragraph, 4th sentence, pg 5-7: why will these rates be determined on a per-grid-cell basis, and not on a group of cells in one particular area?

    Response: The rates will be calculated on a per-cell basis by the model; however, they could be evaluated on a per-cell or group of cells basis. The most appropriate methods for evaluation will be determined as part of the modeling work and will be reviewed with the Agency modeling team through meetings, webinars, and/or teleconferences.

15. Section 3.0, Page 3-1, second bullet: Please clarify what this question is asking.

Response: During large events, the equilibrium transport patterns may be perturbed. The model can be used to determine how long it takes the system to return to equilibrium conditions after one of these events. The text of the modeling plan has been revised to clarify this point.

16. Section 3.0, page 3-1, third bullet: Please change "under the no action scenario" to "without remediation" as the analysis would be applicable to both no action and monitored natural recovery scenarios.

Response: The text has been revised as requested.

17. Page 5-3, Section 5.1.2.2: (1) Please describe how the existing SedFlume data will be incorporated into the model and the associated uncertainty.

    Response: The Sedflume data will be analyzed site wide and appropriate methodology will be developed for the incorporation of the erosion rate and critical shear stress parameterizations as part of the modeling work. The appropriate methodology cannot be defined a-priori. The text has been revised to indicate this.

18. Page 3-3, Section 3.5 (first bullet) and Page 5-7, Section 5.2.2 (first paragraph):
    As stated in the Modeling Plan Addendum, projecting recovery of surface sediment concentrations is critical to the evaluation of remedial options. Please describe the methods and mathematical equations that will be implemented for this forecast. Please explain how the various model components will be integrated to predict recovery and risk.

    Response: The sediment transport modeling work will provide accumulation rates that comprise the "burial" component of sediment recovery. While burial is the primary component of recovery, the analysis does not directly evaluate the mixing, diffusion, advection, and other transport components important to final recovery. As stated, "The model will support an understanding of sediment bed interactions and redistribution processes that effect COPC recovery rates ...". These analyses will be conducted as part of separate work not outlined in this sediment transport model work plan; however, the sediment transport modeling will contribute a primary component of that analysis. Any additional analyses beyond those described in the Modeling Plan Addendum will be reviewed with the Agency modeling team through meetings, webinars, and/or teleconferences

19. Page 4-2, Section 4.2.1 (last bullet): Please state the approximately 2-year time period when velocity and salinity data were collected.

    Response: The text has been revised to include Spring 2009 through Fall 2011.

20. Page 4-5, Section 4.2.3.3 (first paragraph) and Figure 2: The x-axis (Figure 2) suggests that the model calibration started on May 29 (not May 19 as stated in the text) and covered approximately 6 days. While the text explanation is understood (that the model was calibrated during a "dry spring event"), it is unclear why a multi-year dataset was calibrated on a 6-day period only. The text in Section 4.2.3.3 infers that other calibration periods were used (in addition long-term calibration is discussed in Section 5.1.3, page 5-4, second paragraph). Please describe the other calibration periods tested and present the results of these calibrations using a coefficient of determination and/or Nash-Sutcliff Index to compare the observed data and simulated data.

    Response: The hydrodynamic model calibration included the following primary calibration conditions/periods: 1) dry weather, neap tide (August 29 – September 05, 2010); 2) dry weather, spring tide (May 29 – June 05, 2011); and 3) wet weather rainfall event, spring tide (August 10 – 16, 2011). These calibration periods were selected based on a review of the 2-year monitoring data set to encompass the range of prevailing tidal and typical storm conditions in the system. The primary validation period selected for the hydrodynamic model was the period of the dye tracer study (May 10 – 20, 2011), which includes dry weather neap tide conditions and wet weather spring tide conditions. A full analysis and discussion of the hydrodynamic model calibration will be discussed in the Modeling Report, which will be included as an appendix to the RI Report. This presentation will include model predictions across the entire 2-year monitoring period. The example provided in the Modeling Plan Addendum is only for illustrative purposes and a detailed discussion is beyond the scope of the Addendum. There are many methods that can be used to evaluate the model calibration (i.e., the fit of the model simulated data to the observed data during the calibration period); and all appropriate methods are being considered. The most appropriate methods for the specific datasets of interest in a tidal wetland will be reviewed with the Agency modeling team through collaborative meetings, webinars, and/or teleconferences, and will be presented quantitatively in the modeling report.

21. Page 4-6, Section 4.2.3.4 (first paragraph) and Figure 3: The validation results presented in Figure 3 cover short time periods (approximately 7 days) for four tidal cycles. Please explain why these specific time intervals from 2010 and 2011 were selected for validation and presented. For example, do these periods show the best simulated data compared to the rest of the multi-year data? Section 5.1.3 (page 5- 4, second paragraph) indicates that both long-term and short-term validation periods will be examined. Please indicate if a one-year validation period was tested; if so, please provide the coefficient of determination and/or Nash-Sutcliff Index to compare the observed data and simulated data.

    Response: The primary validation period was selected to encompass a unique period from the calibration periods that encompasses a range of site conditions (see above comment response). The model performance with respect to simulating observed conditions was not and should not be considered in the selection of the validation period. As discussed in the above response, the Modeling Report will include a discussion of the model predictions across the full 2-year monitoring period.

22. Page 5-5, Section 5.1.3 (last paragraph): The Modeling Plan Addendum states that ancillary metrics will be used to evaluate the performance of the sediment transport model. It is unclear if the text is referring to parameters such as grain size and cohesiveness, which will also impact sediment transport. Please clarify sentence.

    Response: Metrics for evaluation are data that can be used for model comparison. Ancillary metrics may include items such as particle size measured at a near bed platform where a qualitative, but not direct quantitative, comparison of water column particle size distribution patterns over short time periods can be made. Generally these metrics will be representative of some temporal change.

USEPA Comment to the QAPP/FSP Addendum (June 10, 2014).

"The QAPP should include a narrative for the usability assessment of the data collected from the optical instrumentation. Who are the personnel that will be performing this assessment? Are data flagged if there are problems encountered during the assessment process? Part of the process is outlined in the SOP #2.4 with the SOP indicating that discussions from the COL-NASA data QA/QC workshop being used as part of the QA/QC process. It is not clear if the recommendations outlined in that workshop will be followed and how they specifically apply to the Berry's Creek optical program. Please provide more information"

The USEPA comment is addressed below in pieces. The comment segment is shown in bold and the response is in *italics.*

The QAPP should include a narrative for the usability assessment of the data collected from the optical instrumentation.

Response: The optical data assessment will consist of 2 phases:

<u>Phase 1 – Data integrity evaluation</u>
During this phase the optical parameter data will be downloaded from the instrumentation. The instrumentation will be evaluated according to manufacturer's specifications to ensure proper functionality during the deployment. Data will be inspected quantitatively and qualitatively by appropriate experts. Any suspect data will be flagged and assessed for usability.

COPC data used to calibrate and validate the optical models will be analyzed and evaluated according to the work plan and QAPP in accordance with standard EPA procedures.

<u>Phase 2 – Data analysis</u>
The optical parameters will be correlated to the COPC data using a Partial Least Squares (PLS) regression. An optimal number of components for the PLS regression will be selected for each COPC. The selection will be based on quantitative variance and qualitative goodness of fit by the expert team. All final PLS regressions will be consistent with previous peer-reviewed methodology. Any deviation or problems arising from this methodology will be clearly flagged and considered in the usability assessment.
The final analysis will be available for interpretation. Any data deemed unusable in the Phase 1 or 2 evaluation will be omitted with a clear explanation.

Who are the personnel that will be performing this assessment?

Response:
Dr. Grace Chang – Optical data analysis expert
Dr. Craig Jones – General expert in measurement and analysis related to transport processes
Frank Spada – Instrumentation expert
Todd Martin – Task project manager and oversight
Other qualified personnel will perform basic analysis as needed; however, the four personnel above will have primary control and responsibility for all assessment conducted.

Are data flagged if there are problems encountered during the assessment process?

Data will be flagged and potentially omitted from the analysis if it is determined to be problematic in the Phase 1 or 2 analyses above.

Part of the process is outlined in the SOP #2.4 with the SOP indicating that discussions from the COL-NASA Data QA/QC workshop being used as part of the QA/QC process. It is not clear if the recommendations outlined in that workshop will be followed and how they specifically apply to the Berry's Creek optical program. Please provide more information.

Response: The recommendations for QA/QC of optical data developed by the Consortium for Ocean Leadership (COL) provide excellent guidance for evaluating the state of the art optical approaches used in this project. The COL outlines general methodology for the evaluation of data usability and methods to ensure that datasets collected are robust. The COL guidance is available in its entirety at http://oceancolor.gsfc.nasa.gov/DOCS/Data QC Workshop Final Report 2012-08-7.pdf.

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October 17, 2014

-- Via E-Mail --

Mr. Douglas Tomchuk
USEPA Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

Re: Berry's Creek Study Area
Phase 3b-2014 Field Program and Modeling Plan Addendum

Dear Mr. Tomchuk:

The BCSA Group has reviewed the comments provided with the July 16, 2012 Conditional Approval letter for the BCSA Phase 3b Work Plan Addendum. Responses to all of the comments are provided herein. If you have any questions related to these responses please feel free to contact me.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

c: John Hanson, Esq.
Gwen Zervas, NJDEP

1. White Perch - Determination of Sex: Determining the sex of adult fish is standard practice. If the white perch are not in reproductive status (that would be externally obvious), the gonads will need to be observed directly by cutting into the fish. This can be done at the time of measuring the fish or when the fish are processed for shipment to the analytical lab. Fish will be opened for otolith removal as stated in the QAPP, "If whole body tissue analyses are to be performed (see project-specific FSP), then care must be taken during otolith removal to retain all tissue and liquids that may result from the otolith extraction. All tissues and fluid need to be included in the whole body sample being sent to the laboratory for chemical analysis." A similar procedure that retains all tissues and fluids should be followed while sexing the fish even though no tissue needs to be removed.

The goal of the current study is to develop a size concentration relationship for PCBs and Hg in white perch and sex is a critical factor for understanding this relationship so must be determined. Significant differences in fish PCB concentrations have been observed in the male and female white perch in the Meadowlands in previous studies. Weiss and Ashley (2007) noted that, "Because the males had much higher PCB levels than the females; the relationship to size was recalculated with separation of sexes. There were very different trends between the sexes, with the males continuing to bioaccumulate over time (as shown with increasing fish length) and the females maintaining a steady state, owing probably to the depuration with the eggs."

In order to achieve the DQO of developing a size concentration relationship for PCBs and Hg in white perch, the Group should attempt to catch and analyze 5 of each sex from each area.

RESPONSE: As a point of clarification, the DQQ for this portion of the study is to determine if COPC concentrations are higher in larger fish. The goal of the study *is not* to develop a definitive size concentration relationship, as stated in the comment above. To do so would require a significantly greater sample collection effort than proposed to compile data sufficiently robust to support generation of a quantitative relationship.

Nevertheless, the Group will modify the current proposed work scope to include a determination of the sex of those large white perch to be analyzed for COPCs under Task 16C – White Perch Population Aging and COPC Analysis. As previously proposed, 30 of the largest perch (> 200 mm) were to be selected for COPC residue analysis with five perch collected from each of UBC, MBC, BCC/LBC, upper Bellman's Creek, lower Bellman's Creek, and Mill Creek. To address the EPA request for inclusion of five of each sex from each reach, the scope of this task will be increased to 60 total fish. Ten perch will be collected in each reach (UBC, MBC, BCC/LBC, upper Bellman's Creek, lower Bellman's Creek and Mill Creek). Five male and five female fish of the largest class (> 200 mm) will be retained from each area for COPC residue analysis and aging. Perch sex will be determined in the field lab via dissection and observation of the gonads. As a point of caution, based on discussion with fishery biologists and researchers, sex determination in white perch is not always definitive. Changes in the look and character of the gonads depending on the season provide some challenges to sex determination in some situations. We will identify the sex via gonad observation, but if the sex cannot be determined definitively, we will note the sample as indeterminate.

2. PCB Congener Analysis of Biota: Please include a table of the PCB congeners that will be provided for the tissue analysis and the corresponding detection limits.

RESPONSE:
QAPP Worksheet #15 of the Phase 3b 2013 QAPP has the list of congeners in tissues with the corresponding quantitation limits and method detection limits. A copy of this worksheet has been included for convenience.

3. QAPP, General: The submitted documentation should also be revised to include some of the proposed addition and clarifications from the July 3, 2014 Response to Comments on the Phase 3b-2014 work Plan Addendum.

RESPONSE:
The QAPP has been updated to reflect changes discussed in the 3 July 2014 letter.

4. QAPP, Worksheet 9 (PDF page 25): A summary of agenda items from recent interagency meetings are provided in Worksheet 9. It would have been more beneficial if the decision points were included to document how the field plan was scoped and developed.

RESPONSE:
The scope of work for the Phase 3b 2014 field tasks was determined based on discussions with the Agency as noted in Worksheet #9 and identification of data needs based on ongoing data analysis. The rationale for each of the tasks is described in the Work Plan Addendum.

5. QAPP, Worksheet 14 page 3 of 12: At the top of the page, it was indicated that for Task 15c at least five locations will be collocated with existing sediments cores advanced to Pleistocene sediments will be compared to the findings of the coring and probing tasks to help characterize the precision and accuracy of the probing approach. Please clarify what the comparison criteria or conditions that would make the results of the probing acceptable to use for the project.

RESPONSE:
The evaluation of data usability for the Holocene sediment probing task will depend upon the desired application of the data. As discussed in the Work Plan, there are several probable data uses, including (i) a supplemental source of data for evaluation of natural recovery patterns, (ii) support to the sediment transport model development, and (iii) evaluation of sediment remedial alternatives in the FS. Some of the data needs for the Holocene sediment thickness are more semi-quantitative in nature, whereas others may entail a more direct quantitative use of the data. Quantitative Data Quality Objectives (DQOs) have not yet been developed for these different uses and may not ultimately be developed. If differences in estimated depths between probing and coring methods are found to be significant with respect to the intended use, the Group will evaluate the data in more detail to assess its suitability for use.

6. QAPP, Worksheet 14, Task 15A (PDF page 33): Sampling of the recently deposited material on top of the Pilot Study sand plots is beneficial because the depositional time horizon can be defined by the construction of the sand plots. However, sampling of the reference sites (Mill Creek and Bellman's Creek) is undefined (i.e., the depositional time horizon is not confirmed). Please include beryllium-7 analysis in the reference area samples to confirm that the sediments are "recently deposited."

RESPONSE:
The BCSA Group agrees that sampling Reference Site thin BAZ sediments for ^{7}Be may be beneficial and agrees to do so.

However, it is important to state prior to the sampling our understanding of ^{7}Be occurrence and how the forthcoming results should be interpreted. ^{7}Be has a short half-life (55 days) and is commonly considered an indicator of sediment deposition in the timeframe of approximately 1 year prior to sample collection. ^{7}Be is typically incorporated into actively depositing sediment via atmospheric deposition and mixing into the sediment as it is deposited. Specifically in the context of BCSA, the Group has found that ^{7}Be activities measured in BCSA sediments are approximately one order of magnitude above reporting limits. Therefore, ^{7}Be that has been present in BCSA sediments for approximately three decay cycles (i.e., approximately 6 months) may be undetectable, even under the assumption that the full 2.5-cm sampling interval is deposited at once (nominal waterway deposition rates are estimated to be on the order of 0.5 – 1 cm/y). Additionally, it is likely that sediment deposition, while ongoing, occurs in an episodic fashion over the course of a year, due to seasonal cycles and short-term variability in weather patterns and associated system energies. For these reasons, there are multiple scenarios in which ^{7}Be may be undetectable even if ongoing deposition is occurring over the timescale of several years (i.e., false negatives may occur). If ^{7}Be is detected in the Reference Site thin BAZ, we can conclude that sediment has been deposited in the last 6 months or more recently (most likely less than 3 months). Conversely, if ^{7}Be is not detected, it cannot be concluded that sediment deposition has not occurred in recent years.

7. QAPP, Worksheet 14, Task 15A (PDF page 33): Task 15A includes the collection of 5 surface sediment samples at co-located biota locations to support the food web study. These samples will be analyzed for stable isotopes. Please explain why this sample size was selected and whether it is sufficient to characterize the isotopic signature in the sediment bed and confirm the isotopic delta that occurs during ingestion and bioaccumulation.

RESPONSE: Stable isotopes of nitrogen, carbon and sulfur were analyzed in several biotic compartments in 2011, and a report of the results and data analysis are provided in Appendix L to the Phase 2 Site Characterization Report (Geosyntec/Integral 2012). In that study, no sediments were collected, but marsh detritus, consisting of senesced leaves of Phragmites, were sampled. In both BCSA and reference areas, amphipods were found to be at a lower trophic level than marsh detritus, suggesting that amphipods derived food from some source that was not characterized by the study, such as the sediment bed. Data to be collected in 2014 and analyzed for stable isotopes will include sediment, which is a mixture of various types of organic and mineral matter, and may be a more important source of nutrition for amphipods than other media previously collected. Stable isotope data for sediment will illuminate the extent to which amphipods and other biological components and food webs are supported by energy derived directly from sediment. Clarification of these relationships will support refinement of the conceptual site model as it relates to and describes bioaccumulation.

Because there are no stable isotope data for sediments from the prior study, there was no basis for understanding variability in the related parameters, from which a statistically rigorous sampling and analysis plan could be formulated. The number and spatial density of sediment samples therefore may not be suitable for certain statistical analyses. Instead, the results of the analysis of stable isotopes in sediment samples will be analyzed qualitatively first, to evaluate consistency in trophic patterns across all 10 sampling locations. If warranted, data may be aggregated within reaches, or across the entire study area, for subsequent quantitative analyses, e.g., evaluating statistical correlation between $\Delta^{15}N$ and mercury concentrations. If so, uncertainty in results will be clearly defined. Either quantitative or qualitative relationships will inform the bioaccumulation CSM.

8. QAPP, Worksheet 14, Task 15B (PDF page 33 and 34): Please provide more rationale on why 100-foot transects will support the data quality objectives.

RESPONSE:

The bathymetric survey scope will replicate the prior survey completed in 2008, which also used 100-foot transects. This spacing provides adequate spatial resolution and accuracy (±0.1 foot) to understand the morphology of the waterway.

9. QAPP, Worksheet 14, Task 16A (PDF page 36): Task 16A indicates that surface sediment, surface water, and biota sampling will be collected to support the food web model. Please provide more rationale how 10 locations (1 sample per location) will provide a sufficient sample size to characterize isotopic signatures within the food web.

RESPONSE: As noted in the response to comment #7, either quantitative or qualitative relationships that can be derived from the food web study will inform the CSM. The work planned for 2014 will build on the results of the 2011 food web study by providing 5 full suites of stable isotope and COPC data at distinct locations within each of the two uppermost reaches. Initial analyses will center on the consistency between sampling locations and between reaches. If consistent patterns are observed across the spatial extent of the area sampled, aggregation of data for additional, possibly quantitative, analyses will be considered. Resulting quantitative analyses will include discussion of uncertainty. If results are not qualitatively consistent in different sampling locations, this may be considered evidence of an important spatial distinction that will further inform the CSM.

10. QAPP, Worksheet 14, Task 16B (PDF page 36): Task 16B states that surface water samples will be field filtered to generate "unfiltered" and "filtered" samples using a 0.45 m filter. Please confirm that ancillary parameters such as dissolved organic carbon and total suspended filters will be filtered with the same filter type. If an alternative filter size is planned, please provide rationale and explain the implications on data comparison.

RESPONSE:
A 0.45 micron filter is used to field filter TAL metals and dissolved organic carbon. Similarly, the laboratory will filter samples collected for analysis of dissolved MeHg, Hg, and PCBs as well as total suspended solids using a 0.45 micron filter. Hence, the filtration particle size will be consistent across the program.

11. QAPP, Worksheet 14, Task 18A (PDF page 40): A caveat statement was added to Task 18A stating that planned high resolution sediment cores may be moved to "areas of higher potential flow velocities." Since areas of high flow velocity tend to accumulate coarser grained material, it is unclear why sediment cores would be collected and tested for radiochemistry (especially since radionuclides are particle reactive and tend to accumulate on finer grained material.

RESPONSE:

Since the objective of the Task 18A coring is to evaluate sediment stability in Upper Peach Island Creek, it is desirable to test areas with a higher potential for sediment resuspension. Such areas will be characterized as having higher flow potential and, potentially as a result, more coarse-grained sediments (e.g. sand). The reviewer comment is understood; however, the first priority of the work is to test in areas that are understood to have relatively high potential velocities to evaluate long-term sediment stability in these areas. The presence of coarse-grained sediment in the cores will be noted and considered as an important factor in the interpretation of the data.

Probing activities performed as a component of Task 18B (Flow Velocity Measurements and Sediment Texture Mapping) have identified some sand presence in the western portion of Upper Peach Island Creek; however, with one small (4 cm thick) exception, in all cases the sand was classified as a silty sand. Intervals with a high proportion of sand tend to be relatively thin (a maximum of 8 cm observed). Hence, even though the objectives of the program led to the targeting of higher-velocity locations with potentially higher sand content than elsewhere, the sediment profile is anticipated to still be predominantly silt, which is amenable to geochronology.

12. QAPP, Worksheet 14, Task 18A (PDF page 40): Please include beryllium-7 to the analytical suite reported for the top 0-2 cm sediment interval of the high resolution sediment core to characterize the sampling location as recently deposited. Note that the laboratory will be recording Be7 with the same gamma spectrometer as Cs137, so no extra analysis or sample mass is needed.

RESPONSE:
Similar to the first comment above, the BCSA Group agrees that adding ^{7}Be analyses to the top sampling interval may be beneficial to the interpretation of sediment deposition. However, the same considerations in data interpretation discussed above apply to this scope. Specifically, if ^{7}Be is detected in the top sampling interval of the high-resolution cores, we can conclude that sediment has been deposited in the last 6 months or more recently (most likely less than 3 months). Conversely, if ^{7}Be is not detected, it cannot be concluded that sediment deposition is not occurring in recent years.

It should be noted that although gamma spectroscopy is utilized for both ^{137}Cs and ^{7}Be, due to differences in energy (Kevs) between the two radioisotopes, additional sample mass is required to meet the 0.4 piCu/g minimal detectable activity for ^{7}Be.

Additionally, we plan to add ^{7}Be analyses to each of the top three sampling intervals (0-2 cm, 2-4 cm, and 4-6 cm) of cores in both the UPIC (Task 18A) and Sitewide (Task 21) coring tasks. This will provide a more comprehensive understanding of the source of ^{7}Be in sediments by differentiating between locations with a continuous profile of ^{7}Be in the top 6 cm, which suggests a more continuous record of deposition, and those with more sporadic detections of ^{7}Be in the profile, which are indicative of more episodic deposition of recent sediments.

13. QAPP, Worksheet 14, Task 19 (PDF page 42): Oversight field crew have observed and noted human activity under the Route 3 bridge, which has not been captured by the camera (which records one photo every 30 minutes). A caveat statement should be added to the QAPP (as well as supplemental document that use the digital imagery) that the camera do not record all human activity and usage in Berry's Creek.

RESPONSE: A statement will be added to the QAPP Task 19 and associated worksheets to clarify that the digital images are collected at a frequency of 30 minutes and may not record all instances of human activity and usage in Berry's Creek.

14. QAPP, Worksheet 18: There are errors or missing SOP references for some of the activities listed with each tasks. The SOP listing needs to be verified. For example, Tasks 15-Holocene and Pleistocene Probing referenced SOP 3.9 which is associated with the extraction of porewater. The FSP references SOP 3.10 for the Unconsolidated Sediment Thickness Probing that was included as Appendix C of the current submittal. Please note that this SOP number along with SOP numbers 3.11 and 3.12 were used to designate SOPs that were part of the work associated with Phase 3a Addendum Amendment - October 2012. Therefore, the submitted SOP 3.10 should be renumbered to avoid confusion with previously submitted SOP with the same number. Additionally, this worksheet needs to be reconciled with SOPs listed for activities listed with each task in the FSP. The worksheet SOP references are not complete when compared to the information in the FSP.

RESPONSE:
The SOP list has been verified as accurate. SOPs 3.11 and 3.12 were not listed as part of the Phase 3a QAPP and FSP Addendum. According to the SOP list from October 2012, June 2013, and now July 2014, the list is comprehensive for the field SOPs developed to date for the project. WS#18 was corrected with regard to missing or mis-referenced SOPs per the referenced SOPs in the FSP.

15. QAPP, Worksheet 22: The SOP reference for the AC-S, the fluorometers and the backscatter sensor should be changed to SOP 2.4 instead of 2.1.

RESPONSE:
This change has been made.

16. QAPP, Worksheet 30 (PDF page 98): Please provide a footnote on the "project specific work instruction" for sediment bulk density analysis.

RESPONSE:
A footnote has been added to WS#30.

17. QAPP, Worksheet 30 (PDF page 99): Surface water will be analyzed for mercury and methyl mercury via Methods 1631 and 1630. Please confirm that sampling will be conducted following "clean hands" method and that shipments will include mercury trip blanks. This information was not clearly stated in the QAPP.

RESPONSE:
SOP 2.2 - "Manual Collection of Surface Water Samples" incorporates EPA Method 1669 requirements for the "clean hands" method. The QAPP does not require mercury trip blanks to be shipped with surface water samples.

18. FSP Task 15A, Section 2.1.4.2 (Page 2-3): According to the Field Sample Plan, surface sediment from reference areas will be collected using sediment sampling techniques described in SOP 3.2. Please state clearly the intended method since SOP 3.2 provides a variety of coring techniques including box cores, vibracores, and piston cores.

RESPONSE:
The FSP text has been updated to identify specific sampling methods. Samples will be collected by hand, box corer, or piston corer depending upon station morphology and access conditions.

19. FSP Task 15B, Section 2.2 (Page 2-4): Please describe what criteria will be followed to classify a "major tributary". Please provide a table or map showing the anticipated "major tributaries" that will be surveyed.

RESPONSE:
Major tributaries are generally identified based on size (length/width) and flow volumes, although no quantitative criteria have been established. A figure depicting the tributaries to be surveyed is attached.

20. FSP Task 16A, Section 3.1.3 (Page 3-9): According to the FSP, benthic infauna and amphipods will be collected and shipped to a taxonomy laboratory for sorting. Following sorting, "the taxonomy laboratory will ship samples for stable isotope analysis to the chemical laboratory for pre-analytical processing." Please clearly state the instructions that the laboratory will follow for selecting samples.

RESPONSE: Further clarification will be added to describe procedures of the taxonomic laboratory for sorting and processing benthic Infauna and amphipod samples for identification and analysis of stable isotopes in the FSP. The taxonomic laboratory is responsible for sorting out all of the benthic infauna into composite samples for each sample location. The taxonomic laboratory will additionally identify and enumerate the benthic infauna. Amphipods will be composited separately into a discrete amphipod sample for each location. The taxonomic laboratory will also weigh each composite sample and communicate the final wet weight to the project manager prior to shipment of samples to the chemical laboratory for pre-analytical processing.

21. FSP Task 16A, Section 3.1.4 (Page 3-9): A total of 10 suspended particle tows are planned.
Please state the portion of tows that will occur in the daylight and evening. Please provide rationale for the distribution of samples.

RESPONSE: The total number of suspended particulate tows to be taken in 2014 is eight. This will be corrected in the FSP text and further clarification on the rationale for the sampling approach will be provided to describe the combination of day/night and ebb/flood sampling periods within each reach. Suspended biological tows will be conducted in the day/ebb tide, day/flood tide, night/ebb tide and night/flood tide in each reach, UBC and MBC, for a total of eight samples. These suspended biological tows are meant to be a qualitative representation of the suspended biological material representative of the reaches targeted for the other media in the food web study, UBC and MBC.

22. Work Plan General Comment: Suggest changing "collocated" to "co-located" throughout the document.

RESPONSE:
The comment is noted.

23. Work Plan, Task 15A, Section 2.2.1.2.3, Page 2-4: During field reconnaissance of the WRTG Pilot Study plots, please consider selecting sampling locations at or near Phase 3b WRTG recently deposited sediment sample locations collected in 2013. Co-located sampling will provide another opportunity to compare current and past results within the WRTG removal area.

RESPONSE:

It is not clear if the comment refers to sampling in the WRTG vicinity Pilot Study (PS) plots or the WRTG Removal Area, which are two distinct features. Regardless of the distinction, however, the Group does not recommend attempting to replicate 2013 sampling locations in 2014 sampling. We have observed that the morphology of recently deposited sediment can be spatially variable, e.g., the PS plots show minor variations in the deposited sediment thickness within one plot. Furthermore, these patterns can change over the course of a year with routine reworking of the thin sediment layer, as discussed in the Phase 2 Site characterization Report (Geosyntec/Integral, 2012). Changes can arise due to water flow or, in the case of winter 2013-2014, ice floes observed in the upper reaches. Since the sampled layers are thin, these spatial and temporal variations in recently deposited sediment thickness are anticipated to cause temporally changeable COPC concentrations at any one point. Hence, it will be preferable to compare the two years' datasets as groups instead of on a point-by-point basis. Additionally, in the case of the WRTG Removal Area, this test area may have experienced considerable disturbance in the last year due to the replacement of the WRTG itself. Hence, point-by-point concentration comparisons within this area are not predicted to be informative.

24. Work Plan, Task 15A, Section 2.2.1.2.6 (Page 2-5, first paragraph): Please use consistent analyte definitions. "Mercury" is specified in Section 2.2.1.2.6 while "Total Mercury" is specified in Section 2.2.1.2.5.

RESPONSE:
The comment is noted and the work plan has been updated to specify Total Mercury where appropriate.

25. Work Plan, Task 15C, Section 2.2.3.2 (Page 2-8): Sediment probing provides a qualitative assessment of geological strata. For the sediment probing task, only five probing locations will be co-located with sediment cores, yielding a 3 percent quality assurance program on probing. This frequency may not provide sufficient quality assurance on the accuracy of the probing due to the subjective nature of "feeling" resistance through the probing device. Please consider co-locating a minimum of 15 locations (10 percent of proposed locations) with either existing cores or collecting co-located confirmatory cores to characterize the precision and accuracy of the probing approach.
RESPONSE:

Please see the response to Comment #5. Overall, it is premature to develop a strictly quantitative approach to methods comparison in this scope, since the data uses, as discussed above, may be semi-quantitative in nature. The probing work that is being completed for the Task 18B sediment texture mapping will use a similar approach as Task 15C, but confirmation cores will be completed at approximately 50% of the locations. The Task 18B work will provide a measure of the accuracy and precision of the proposed approach for penetrating the soft sediments and differentiating soft vs. coarse or firm materials. Additionally, measurements from the Task 15C probing will be compared to other available datasets indicating Holocene sediment thicknesses (i.e., sub-bottom profiling, and sediment core data from nearby locations), which will provide additional means to evaluate the consistency of the probing results.

26. Work Plan, Task 16A, Section 2.3.1.1 (Page 2-8) and Figure 2-4: The third sentence in this section states that "The sampling will be conducted at a subset of the stations sampled as a part of the baseline monitoring program, targeting every other sample location throughout each reach." Figure 2-4 shows these sampling locations; however, there are several locations that do not follow the "every other sample location" scheme. There are two food web/COPC uptake sample locations that have a gap of two baseline monitoring locations between them, specifically, (1) in the reach between Nevertouch Marsh and Eight Day Swamp and (2) in the reach between Ackerman Creek Marsh and Walden Swamp. Please provide clarification on sample design.

RESPONSE: The sentence on page 2-8 of section 2.3.1.1 for Task 16A will be reworded to state that "The sampling will be conducted at a subset of the stations sampled as part of the baseline monitoring program, targeting sample locations that correspond to manual or automatic surface water sampling locations throughout each reach." These locations were selected to correspond to the surface water sampling locations for qualitative comparison in the food web study and to provide sufficiently even spatial coverage of each reach of UBC and MBC.

27. Work Plan, Task 16A, Section 2.3.1.2.3 (Page 2-11, second paragraph): Suggest removing the word "ponar" from the third sentence, as the methodology for grab sample collection may vary by location. The updated sentence would read "Three grab samples will be collected..."

RESPONSE:
The suggested revision has been made.

28. Work Plan, Task 16A, Section 2.3.1.2.2 (Page 2-11): The sixth sentence in the section states "The remaining biofilm will be scraped and mixed from all tiles at a single location." Please clarify the number of tiles expected to be used at a single location and how much biofilm is needed to satisfy the analytical requirements.

RESPONSE: Eight ceramic tiles will be placed at each sample location. Details of the ceramic tile placement are provided in the FSP, however clarification of the number of tiles has been added to the work plan text on page 2-11. An additional sentence will be added to the work plan text to specify the minimal sample mass requirements. "The minimal sample mass requirement for stable isotope analysis is 100 mg; however, a sample mass of 5 g will be targeted in order to facilitate homogenization procedures."

29. Work Plan, Task 16A, Section 2.3.1.2.3 (Page 2-11): Benthic infauna and amphipods will be collected for stable isotope analyses and taxonomy. Table 2-2 (Page 1-3) under "Analytical Parameters", the amphipods analytical parameters lists provides taxonomic identification only. Please correct as necessary.

RESPONSE: Amphipods will be collected and sorted for stable isotope analysis as stated in the work plan text Section 2.3.1.2.3. Table 2-2 (Page 1-3) will be corrected to state that Amphipods will be analyzed for stable isotopes.

30. Work Plan, Task 16A, Section 2.3.1.2.4 (Page 2-11): It may be beneficial to clarify the section header and text to read collection of "Suspended Biological Tows," since the words suspended particulates infer to the chemical suspended-phased. Also, please provide rationale for the selection of the 80-micron plankton net. This mesh size seems to be on the larger end of the range of commercially available plankton nets and may result in an inability to collect smaller suspended detritus and microorganisms. Usage of a 1O-micron mesh net could reduce trawling time by capturing more material.

RESPONSE: Adopted suggestion to update terminology for "Suspended Particulate Tows" to "Suspended Biological Tows." Due to the high turbidity of the system we are sampling, decreasing the mesh size beyond the current proposed level would result in significant and immediate clogging of the conical sampler which would interrupt continuous in situ collection. Prior sampling of suspended biota have been conducted with 65-micron nets. Loss of the 65-micron net was followed by replacement with an 80 micron net. Data from Phase 2 showed comparable plankton community structure with samples taken with 80-micron and 65-micron nets. The proposed suspended biological material sampling program mirrors that outlined of plankton sampling in Phase 2, including the use of a larger mesh size, with the exception that protozoa are included in the 2014 Work Plan as possible organisms collected during sampling. Protozoa expected to be collected include larger organisms such as rhizopods and various ciliates with typical dimensions exceeding 100-micron.

31. Work Plan, Task 16B, Sections 2.3.2.1 and 2.3.2.2.1 (Pages 2-13 and 2-14): The rationale for the Fish Creek sample count is unclear. As stated in Section 2.3.2.1, additional data are needed to determine if previously collected samples are representative of the conditions in Fish Creek with regards to elevated PCB concentrations. However, in the proposed plan, two of the three mummichog sampling locations re-occupy previously sampled locations, leaving only one new location. To fulfill the data quality objective in Fish Creek, more than

one new location should be considered. This comment also applies to surface water and sediments sampling co-located with the mummichog samples. Please provide more justification for the proposed sample count.

RESPONSE: The rationale for sampling the same Fish Creek locations as were sampled in 2013 is to provide an additional year of sampling under conditions as equivalent as possible to conditions sampled in 2013. Sampling of the same locations in 2014 will allow for a comparison of mummichog, sediment and surface water collected in 2013 with those collected 2014, in a manner that minimizes the influence of other variables, such spatial heterogeneity in exposures of the fish. Such comparisons will indicate the importance of temporal variation in the variability of tissue concentrations of COPCs as well as possible for a field study. Close correspondence between 2013 and 2014 data under these circumstances would be interpreted to indicate that 2013 samples at these re-sampled locations are, indeed, representative of mummichog in Fish Creek. Sampling in new areas will not provide for this type of comparison. The design for 2014 includes an additional biota sample location to a pre-existing sediment location near the outfall of Fish Creek to broaden the description of conditions in Fish Creek.

32. Work Plan, Task 18A, Section 2.5.1.2.1 (Page 2-23, first bullet): Please provide rationale on why high resolution sediment cores will be advanced to only 1 meter. It is suggested that cores be advanced to the Pleistocene sediments at all locations so that there is confidence that the entire sediment column is obtained and a reliable radionuclide profile can be developed.

RESPONSE:
High-resolution coring performed in Lower Peach Island Creek indicated that testing to a depth of 1 m was sufficient to reach the Pleistocene contact. Since sediment deposition in Upper Peach Island Creek may be limited due to potentially reduced sediment inputs in recent decades resulting from the tide gate placement in the 1960s, we predict that sampling 1 m in UPIC will be sufficient to reach the Pleistocene contact.

33. Work Plan, Task 18A, Section 2.5.1.2.4 (Page 2-25, first complete bullet): The penetration depths, retrieval length, and the geological strata visible through the core tube for the co-located cores should be evaluated prior to collection of geochronological and chemical samples. The core characteristics should be in reasonable agreement with one another (e.g., penetration depths and recoveries should not vary by more than 85%, and any visible strata should occur at the same general depth (e.g., within 4 to 6 inches).

RESPONSE:
We assume that an excerpt of the comment was intended to read as follows: “penetration depths and recoveries should not vary by more than 15%.” We will endeavor to meet the

objectives of the comment. Often, sediment strata are not visually apparent, so it may not always be possible to monitor the consistency of as-sampled sediment horizon depths. In the cases in which we have been able to compare observed depths of like strata between cores, we have generally found their depths to agree within 15%, with only minor exceptions. Differences of this magnitude (15% or greater) in strata depths between cores will be noted in field notes.

34. Work Plan, Figure 2-8 "High Resolution Sample Locations for Radioisotope and COPC Analysis in UPIC": The color coding for "Proposed UPIC Waterway Sample" symbols differs between the map and legend (blue versus orange). Please revise the figure as appropriate for consistency.

RESPONSE:
This change was implemented in the version of the Work Plan submitted on 3 July 2014.

35. Work Plan, Table 2-2 (Page 1 of3 Task 16A), Analytical Parameters: Please clarify why fiddler crabs are undergoing analysis for TAL metals while the other non-microorganisms, Phragmites, and detritus are not. Please correct as necessary.

RESPONSE: Previous sampling of fiddler crabs has not included TAL metal analysis, whereas Phragmites sampling in 2010, Phase 2 included analysis of TAL metals in addition to mercury, methyl mercury and PCBs. Thus, data on TAL metals in Phragmites are sufficient for risk assessment. The data quality objective for fiddler crab sampling is to address the need for more data on TAL metals in fiddler crab to support ecological risk assessment for receptors that consume these marsh invertebrates.

36. Work Plan, Table 2-4, Task 18A: The total samples to be tested for Marsh and Waterway cores are listed as 19 and 29 respectively. Based on 6-60 cm and 6-100 cm cores having 2 cm intervals and archiving every alternate sample, the total number of samples to be tested adds up to 16 and 26 respectively for Marsh and Waterway cores. Please clarify sample count.

RESPONSE:
The specific number of samples collected for each core will depend upon the decision of which alternating samples to collect. We assume that EPA has inferred alternating samples to begin with the interval 8cm-10cm below ground surface (resulting in 16 and 26 samples, respectively), so we will implement the program to be consistent with this design.

Final
Attachment A3: Compilation of BCSA Group Responses to EPA Comments on MESA and PAR

EPA Comment Response Summary

Berry's Creek Study Area Remedial Investigation

Submitted to

U.S. Environmental Protection Agency

Submitted by

Berry's Creek Study Area Cooperating PRP Group

September 2017

THE ELM GROUP

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February 12, 2010

-- Via E-Mail and U.S. Mail --

Mr. Douglas Tomchuk
U.S. Environmental Protection Agency
Region II
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: BCSA Response to USEPA comment letter dated November 23, 2009 regarding the Draft Memorandum on Human Exposure Scenarios and Assumptions

Dear Mr. Tomchuk,

This letter provides the responses of the Berry's Creek Study Area (BCSA or Site) Cooperating Parties Group (the Group) to the comments provided by the US Environmental Protection Agency (USEPA) on the Draft Memorandum on Human Exposure Scenarios and Assumption in a letter dated November 23, 2009. The Group's responses are below and reflect the discussions between the Groups' consultants and USEPA during our meeting on February 3, 2010 at USEPA's offices in Edison, New Jersey.

As we previously agreed, the Group will not revise and reissue the subject report, but instead will incorporate the agreed upon approaches and assumptions into subsequent submittals regarding the baseline human health risk assessment (BHHRA) for the BCSA.

Our responses are presented below for each USEPA comment in the November 23, 2009 letter.

General Comments

1. ***If new information (sampling results, first-hand or photographed observations, interviews with community residents, etc.) suggests that an exposure pathway that was previously deemed negligible is more significant, please update the CSM and exposure scenarios for the risk assessment.***

   The Group agrees to update the CSM and exposure scenarios as new information on site-specific exposure pathways becomes available.

2. *EPA requires that the construction workers, utility workers and child anglers are quantified as potentially exposed populations. Depending on age, child anglers may fish alone or with an adult, from the shoreline or from a boat. If an existing quantified population is considered comparable to any of these, warranting only a qualitative evaluation, please provide an explanation.*

   The Group agrees to include a construction worker and a child angler as potential receptor groups in the BCSA. As discussed during our meeting on February 3, the construction worker will be a worker engaged in some type of construction activity in the waterways that will require excavation of deeper sediments (e.g., a worker putting in a new tide gate or a bulkhead).

Specific Comments

1. *Page 2-4, Section "Physical Settings": The New Jersey Department of Environmental Protection (NJDEP) surface water classification(s) should be added along with intended uses.*

   The Group will include NJDEP surface water classifications in future descriptions of the BCSA.

2. *Page 5, 2~ paragraph: "Residential areas are located further away from the waterways and marshes and beyond industrial areas in most cases, except along some localized portions of the Riser Ditches upstream of the tide gates. Given the distance (greater than 500 m in most portions of the BCSA) between the tidal portions of the BCSA and residential development and the focus of the RI/FS in the tidal portion of the BCSA where development is precluded by zoning (environmental conservation); as well as wetlands and stream encroachment regulations, a residential exposure scenario was not included in the CSM." EPA agrees that the residential scenario is a less likely exposure scenario than perhaps local workers and recreational users of the BCSA. However, even in the tidal regions of the BCSA, residential areas are within a mile. Perhaps older children (12-18) might ride their bicycles to this area. EPA requires that adult and adolescent residents be evaluated quantitatively. If an existing quantified population is considered comparable to either, warranting only a qualitative evaluation, please provide an explanation.*

   As agreed during our meeting, the most plausible and likely use of the BCSA is by nearby residents who will go to BCSA to recreate at the creek. The BHHRA will include residential receptors with recreational exposures at the BCSA, consistent with Site-specific assumptions on exposure frequency and duration noted in the draft Exposure Memorandum and as discussed in our meeting. As requested in USEPA's comments, an older child (12-18) will be evaluated, along with adults and younger children.

3. ***Page 5, 3rd paragraph: "The dense stands of Phragmites that border the main channel of Berry's Creek and many of its tributary creeks limit human access to the creek and the marshes and data from these areas will not be used when estimating exposure concentrations for direct contact, consistent with EPA guidance (1989)." Areas with evidence of trespassing (paths through Phragmites as were observed during a Site visit) should be evaluated.***

   As agreed during our meeting, the BHHRA will evaluate some future recreational use of the marsh. The specific uses to be considered will be determined after discussions with representatives of the Meadowlands Commission to understand the types of recreational development that are reasonably anticipated to occur in *Phragmites* wetlands. A future recreational use could include a person walking on a boardwalk or elevated walkway. Under current use conditions, use of the *Phragmites* marsh will be limited to people walking through the marsh to gain access to the waterway, consistent with the field observations noted in USEPA's comment.

4. ***Page 5, 4th paragraph: "The BSCA has a range of brackish salinity that fluctuates and is not a source of potable water for human receptors currently or in the future." Please include the surface water classification for Berry's Creek to support this statement.***

   The BHHRA will include surface water classifications and other information to support statements regarding the lack of actual or potential drinking water use of Berry's Creek water.

5. ***Page 7, 1st paragraph: "For both kayakers and canoers visiting the area, exposures are expected to be short (one day) and to occur infrequently (i.e., once or twice a year during the warmer months)." The purpose of the risk assessment is to evaluate a reasonable maximum exposure. EPA believes that an exposure frequency of 39 days (1 day per week in the spring, summer and fall) for the RME scenario and 19 days for the CTE are more appropriate.***

   The BHHRA will adopt USEPA's proposed CTE and RME exposure assumptions of 19 and 39 days per year, respectively, for the future use scenario. The current use scenario will assume more infrequent use, to avoid inconsistency with site observations, as outlined in the Draft Memorandum.

6. ***Page 7, 4th paragraph: "In addition, the comparative exposure frequency and duration for visitors would be substantially less than for individuals who live and work in the study area." Please add that the residential and local worker exposure scenarios are expected to be protective of a visitor exposure scenario.***

The BHHRA will include a worker and resident exposure group, as noted in General Comment #2 above. The BHHRA will note that residential and local worker exposures will be protective of visitors.

7. ***Page 7, last paragraph: It is possible that some adults may bring their children fishing with them.***

   The BHHRA will include a child angler.

8. ***Page 8, 1st paragraph: While there are no USEPA studies evaluating the consumption of recreationally caught fish by children, at two other major water bodies in the Region, fish ingestion rates for older children (6 to less than 18) were estimated to be two-thirds that of an adult and for younger children (up to 6 years old), it was estimated that the ingestion rates would be one-third that of an adult. This approach has been peer-reviewed. To remain consistent in the Region, EPA requests that the same ingestion rates for the same age groups be estimated. EPA requests the same assumption be made for blue crab ingestion rates. An additional consideration for blue crab consumption is how much of the hepatopancreas is likely to be consumed as most contaminants concentrate in this organ.***

   The BHHRA will use USEPA's requested assumption that older children (6-18 yrs old) consume fish at a rate that is 2/3 that of adults, and that younger children (0-6) consume fish at a rate that is 1/3 that of adults. The BHHRA also will include evaluation of exposure to a the blue crab hepatopancreas assuming some of it can be consumed by some anglers along with muscle meat.

9. ***Page 8, 1st paragraph: Anglers that work at the commercial/industrial properties that border the BCSA could also "take their catch home for consumption," in addition to nearby residents.***

   The BHHRA will note that, like nearby residents, any local workers who fish and crab in the BCSA could take their catch home for consumption.

10. ***Page 8, 2nd paragraph: The text states that the tide gate maintenance scenario will be evaluated qualitatively. Please state which quantitatively evaluated scenario is assumed analogous to the tide gate scenario. EPA believes that elevated exposure parameters, such as dermal absorption of sediment and time in direct contact with surface water would be elevated over other quantified scenarios even though the exposure frequency would be lower. Please also note that the maintenance cleaning at the West Riser Tide Gate is performed by the Bergen County Mosquito Commission (BCMC). The BCMC may also clean the other tide gates as well.***

The BHHRA will include a quantitative evaluation of a tide gate maintenance worker. The BHHRA will note that the West Riser Tide Gate is maintained by the Bergen County Mosquito commission (BCMC).

11. ***Pages 10 and II, and Table 1: The following potential exposure routes should be discussed in the text and added to Table 1: (a) Tide gate workers/volunteers could also be exposed to surface water via dermal contact (see comment 10, above), (b) Kayakers/canoers could also be exposed to sediment via dermal contact, and (c) and tide gate workers/volunteers and kayakers/canoers could also be exposed to surface water/ambient air via inhalation.***

    The BHHRA will include an exposure pathway for 1) tide gate worker dermal exposure to surface water; 2) incidental sediment exposure for kayakers, and 3) inhalation exposures to volatilized mercury for receptors on the water or on the banks of the BCSA. Inhalation exposures also will be evaluated using ambient air data already collected at the Site by Group members and university researchers. These data will be shared with USEPA prior to the conduct of the baseline BHHRA.

12. ***Page 11, 3rd paragraph: While swimming has not been observed and is not anticipated in the future, the minimum use for surface water bodies under the Clean Water Act is fishable and swimmable. As a result, this exposure scenario must be evaluated.***

    While the Group does not agree that the Clean Water Act requires a swimming exposure scenario to be evaluated for surface water bodies where swimming does not occur and is not reasonably anticipated, swimming will be evaluated as a future use exposure pathway for Berry's Creek. For current use, the BHHRA will include an evaluation of dermal exposure to surface water for an overboard kayaker.

13. ***Page 11, 4th paragraph: "Inhalation of chemicals that have volatilized from surface water into ambient air, though a potentially complete pathway is considered a de minimis exposure pathway given that concentrations of volatile compounds are not known to be elevated in surface water of the BCSA and that any potential exposures would occur in the outdoor environment where volatilized chemicals will be rapidly diffused and dispersed in ambient air." While mercury does not preferentially partition to water, it is likely present at elevated concentrations in the BCSA as a result of the gross contamination present. During future phases of field work, it will be necessary to collect data from a mercury vapor analyzer deployed by boat on Berry's Creek to collect empirical data that may be used to directly evaluate the inhalation of surface water volatiles pathway. The analyzer should be run during a sunny afternoon, at a time of maximum mercury volatilization (high photochemistry potential). EPA acknowledges that mercury quickly diffuses into ambient air; however,***

anglers have the potential to be in close proximity to the water, potentially inhaling large quantities of volatilized elemental mercury.

Mercury vapor inhalation exposures will be assessed as noted in comment response #11 above.

14. ***Page 12, 4th paragraph: "Most (exposure pathways) can occur in each of the BCSA segments. However, the likelihood is that exposures will be less likely and/or frequent in some reaches compared to others (e.g., less fishing in UBC, boating only in LBC or BCC)." Page 4, 4th paragraph states that "Therefore, only one human health CSM is presented in this memorandum and exposure pathways are not characterized separately for each study segment." For the purposes of this exposure scenarios memorandum, EPA agrees that it should be assumed that all exposure pathways be considered for all study segments. Discussions regarding the likelihood of exposures in each individual segment should be reserved for the Uncertainties section of the BHHRA.***

As we agreed at the meeting, the BHHRA will include an evaluation of some human health risks on a reach by reach basis due to differing exposure conditions. To the extent applied, the BHHRA will evaluate all exposure pathways that are relevant to each reach. The BHHRA will include justification for any pathway that is not evaluated in a given reach.

15. ***Page 13, 3rd paragraph: The Baseline Human Health Risk Assessment (BHHRA) should rely primarily on the Reasonable Maximum exposure (RME) scenarios. The Central Tendency Estimate (CTE) scenarios are used to bound the risk estimates and should be discussed in the uncertainty analysis. Consequently, the RME scenarios should be discussed first in the text in this context and presented first in the RAGS Part D tables. In addition, in USEPA Region 2, CTE scenarios need only be analyzed/presented for RME scenarios with risk estimates that are greater than the typical acceptable risk levels.***

The RME scenarios will be presented first in the text and listed first in the RAGS Part D tables. Additionally, the CTE risks will be discussed to provide a risk range for RME risks that are greater than typically acceptable risk levels, consistent with RAGS and risk assessments conducted for other sites in Region 2.

16. ***Page 15, 1st paragraph: The 95th rather than the 90th percentile should be used to evaluate RME fish tissue ingestion rates for the adult. From the referenced document, this corresponds to 49.6 g/d.***

As discussed during our meeting, the Group will use the 90th percentile fish consumption rate of 17.4 g/d, in the BHHRA. This value is used by USEPA and NJDEP in deriving water quality criteria, and is in line with consumption rates used by USEPA and others at other waste sites in Region 2 and surrounding areas (e.g., Hudson River, Housatonic River, Onondaga Lake). The BHHRA also will use the Site-specific camera survey to characterize frequency of use of the Site as a source of fish for consumption. We understand that USEPA is further investigating its position on this topic.

17. ***Page 16, 1st paragraph: "The amount of loss depends upon the chemical as well as the method of cooling." It appears that 'cooling' is a typo and should be 'cooking'.***

    This typo will be corrected.

18. ***Page 17, 1st paragraph: EPA realizes that the BSCA may not be as attractive a water body as many of the other New York sport fisheries included in the Connelly et al. (1992) study. EPA proposes using 27 days per year (average) as an RME exposure frequency and 15 days per year (median) as the CTE exposure frequency. Please update RAGS tables accordingly.***

    The proposed USEPA frequencies of 27 and 15 days per year will be used as the exposure frequency to evaluate fishing frequency under future use conditions. RAGS tables will be updated. The Site-specific camera survey data will be used as the basis for current fishing frequency assumptions, as agreed in the meeting.

19. ***Page 17, 3~ paragraph: "For adults, the reasonable maximum exposure duration was 30 years and the central tendency value was 9 years. For children of anglers, the exposure duration was 4 years." Exposure durations (RME and CTE) will have to be updated in the text and RAGS tables to reflect the older child and younger child scenarios.***

    The RAGS tables will be updated to include two ages for the child receptor.

20. ***Page 18, 1st paragraph: "The mean value of 4,447 cm2 of skin surface area for male and female adults combined was developed from data published by USEPA (2004)." It is more likely that the anglers will be mostly male. Therefore a value of 4860 cm2 for skin surface area is more appropriate. Please update RAGS tables accordingly.***

    The BHHRA will use USEPA's requested skin surface area. RAGS tables will be updated.

21. ***Page 18, 1st paragraph: For dermal contact with sediment, EPA recommends using the default sediment adherence factor of 0.2 mg/cm2-event for a child angler/child with angler adult. Please update RAGS tables accordingly.***

    The BHHRA will use the adherence factor of 0.2 mg/cm^2-event for a child receptor.

22. ***Page 18, 2nd paragraph: A mean value of 1,020 cm2 of skin surface area was developed for male and female adults, based on the assumption that only the hands and forearms would regularly come into contact with surface water during angling activities. The actual mean for male and female adults from the referenced document is 2,077 cm2 but since a majority of anglers are expected to be male, EPA recommends using 2,300 cm2. Please update RAGS tables accordingly.***

    The BHHRA will use USEPA's proposed skin surface area of 2,300 cm^2 for anglers.

23. ***Pages 18 and 19, "Event Duration": This section needs to (a) document which values from Table 15-110 were used (i.e., mean and 95th percentile) for RME and CTE and (b) discuss uncertainties with the data (i.e., for time spent outdoors at a pool, river, and/or lake). The source of the parameter values for calculating DA-event for surface water should be mentioned in the text.***

    The BHHRA will include the reference of the source of the values and will discuss uncertainties in the data. The RAGS tables will be updated accordingly.

24. ***Page 19, 1st paragraph: In the text, it is assumed that 10% of the time spent fishing/crabbing would involve direct contact with surface water. EPA recommends using 10% for CTE and 25% for RME. Please update event duration calculation and RAGS tables accordingly.***

    The BHHRA will use 25% for the RME and 10% for the CTE surface water contact frequency while fishing and crabbing, but assume and request that EPA provide the rationale for the higher contact rate before the BHHRA calculations are made Site-specific observations of use indicate that contact with surface water during crabbing and fishing would be very infrequent.

25. ***Page 19, 1st paragraph: Do the event durations of surface water exposures for anglers from the shoreline also apply to anglers from a boat?***

    The BHHRA will clarify the use of equivalent event durations for anglers on shore and in a boat.

26. ***Pages 19 and 20, "References": Some incomplete reference citations (e.g., Burger, 2002 and Stanley and Danie, 1983) should be revised.***

    The BHHRA will include complete references for all cited literature.

27. ***References: Please update links.***

    The BHHRA will include updated links for all internet-accessible references.

28. *Figure 1: Please use a different color to identify the BCSA and include it in a key. The red line selected is too similar to the highways.*

The BHHRA will include updated figures of the study area to make the Site distinguishable from roadways.

29. *Figure 3: Please also evaluate incidental ingestion of surface water by a human and contact/uptake of the ambient air by all receptors except fish.*

Incidental ingestion of surface water and inhalation of mercury vapor will be evaluated for all receptors using the waterways. See response to specific comment #13, above, regarding inhalation exposures.

30. *Table 1: The ingestion of surface water by a recreational user should be evaluated qualitatively. This pathway does have the potential to be complete. As noted previously, the inhalation of ambient air by a recreational user should be evaluated quantitatively. The child recreational users consuming finfish and blue crab will have to be separated into older child and younger child scenarios.*

The BHHRA will include ingestion of surface water and inhalation pathways, and two ages for child recreation users consuming finfish and blue crab.

31. *Table 4 series: The RME tables should be first, followed by the CTE tables. The child exposure scenarios should be updated to the older and younger child. As previously noted, all RME fish tissue ingestion rates for the adult should be changed to 49.6 g/d and those for the child should be changed to 13.4 g/day, using the 95th percentile for fish consumption rates.*

The BHHRA will include the RME tables first. Child exposure assumptions will be updated to reflect the response noted in specific comment #8. The fish consumption rates will be as noted in comments 16 and 8 above.

32. *Table 4.6: Please change the fraction ingested for the RME scenario to 1.0.*

The BHHRA will use the fraction ingested (FI) term consistent with USEPA guidance, and as outlined in the draft exposure memorandum. We do not believe it is reasonable to assume that all sediment/soil that is ingested during a day spent in the BCSA will come from the BCSA. Some soil will come from other activities outside of the Site. We understand USEPA is further investigating its position on this issue.

33. *Tables 4.5 and 4.6: The values for sediment ingestion rate are reasonable but not mentioned in the text. The values for fraction ingested, which are also not mentioned in the text, should be one, at least for the RME scenario.*

The BHHRA will use the FI term consistent with USEPA guidance and as outlined in the draft exposure memorandum. We do not believe it is reasonable to assume that all sediment/soil that is ingested during a day spent in the BCSA will come from the BCSA. Some soil will come from other activities outside of the Site. We understand USEPA is further investigating this position.

34. ***Tables 4.5 through 4.8: In the Units columns, "--" should be replaced with "unitless".***

The BHHRA will include a specific notation for factors that do not have units.

35. ***Tables 4.7 and 4.8): There are two typos in the second equation for DA-event, one in the term (t-event/(l+B)) where the division symbol ("/") is missing and the other in the last term (1+B)2 where the "2" should be superscript.***

The BHHRA will correct the typos in the equation presented in Tables 4.7 and 4.8.

Please do not hesitate to contact me if you have any questions regarding the above responses.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

c: John Hanson, Esq.

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October 18, 2012

-- Via E-Mail --

Douglas Tomchuk
USEPA, Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

RE: Berry's Creek Study Area (BCSA)
Response to USEPA Comments on the Pathway Analysis Report

Dear Mr. Tomchuk:

The Berry's Creek Cooperating Parties Group (BCSA Group) has reviewed the USEPA's comments on the *"Draft Pathway Analysis Report in Support of the Human Health Risk Assessment for the Berry's Creek Study Area, Bergen County, NJ"* dated October 25, 2010. The BCSA Group's responses are attached. These responses incorporate the results of the discussions with USEPA during the meeting on July 13, 2011, in Edison, New Jersey. Of particular note is that the BCSA Group has agreed to the USEPA request that the RAGS Tables 1 and 4 be updated (also attached to this email transmittal) to reflect the current assumptions to the HHRA. A copy of the original PAR submittal, response to comments, and updated tables are posted on the USEPA BCSA web site.

Please contact me if you have any questions or comments regarding the responses and updated tables.

Sincerely,

THE ELM GROUP, INC.

Peter P. Brussock, Ph.D.
Project Coordinator

PPB:ng

Enclosures

c: John Hanson, Esq.

Attachment – October 18, 2012 Letter From Peter Brussock (ELM) to Doug Tomchuk (USEPA)
Berry's Creek Study Area RI/FS
BCSA Group Response to USEPA Comments on the draft Pathway Analysis Report (PAR) in Support of the Human Health Risk Assessment

The Berry's Creek Cooperating Parties Group (BCSA Group) has reviewed USEPA's comments on the *"Draft Pathway Analysis Report in Support of the Human Health Risk Assessment for the Berry's Creek Study Area, Bergen County, NJ"* dated October 25, 2010. The BCSA Group's responses are provided below. These responses incorporate the results of the discussions with USEPA during the meeting on July 13, 2011, in Edison, New Jersey.

General Comments

1. During the February 3rd meeting, it was mentioned that dirt bikes were observed along the perimeter of the upland areas. Please provide more information on this scenario. Have dirt bikers been observed or were tracks identified? Is the area of observed dirt bike activity usually dry? Is it readily accessible? Please either evaluate this exposure pathway or provide an explanation otherwise.

   Response: During the more than 2.5 years of field work, there has been a single observation by the RI field team (in June 2009) of a dirt bike rider near Fish Creek, along the marsh fringe. The marsh fringe is outside the RI area, which is focused on the regularly inundated portions of the marshes, in addition to the waterways. Because the regularly inundated portions of the marshes would be very difficult to navigate with a dirt bike, the BCSA Group does not expect that this activity will occur in this area. The RI team has not observed any sign of dirt bike riding in the marsh interior or any other activity beyond the single occurrence in the marsh fringe. Given the rare occurrence of this activity and its location outside the primary study area, the dirt bike rider scenario is not proposed for inclusion in the risk assessment. This decision will be revisited if the RI team observes additional occurrences of dirt bike riding in the Study Area.

2. Please refer to a child aged 0-6 as a "younger child" and a child aged 6-18 as an "older child" for clarity.

   Response: This change will be made in subsequent risk assessment submittals.

3. While not mentioned in the PAR specifically, USEPA has several comments regarding the development of the HHRA, based on the February 12, 2010 Response to Comments on the draft Memorandum on Human Exposure Scenarios and Assumptions (MHESA).

   a. **SC#16 - fish ingestion rate**: The general USEPA default RME value for freshwater fish consumption is 26 g d-1 and the RME value used at the Passaic River was 25 g d-1, it is reasonable to believe that the waters of Berry's Creek and Canal are less attractive than other freshwater fisheries in the State of New Jersey. USEPA will accept the proposed 17.4 g d-1 as a RME fish consumption rate. In terms of the camera survey, this information generated by this effort may be used qualitatively. The camera study should be treated as observational data to help support our best professional judgment on activities and exposure parameters. This data cannot be used to reevaluate the consumption rates as the rate has already been reduced as a result of the anticipated lower activity levels in BCSA as compared with other, healthier waterways.

Response: Comment noted in relation to the proposed 17.4 g/d fish consumption rate. The BCSA Group agrees that the camera survey cannot be used to quantify fish consumption rate. The BCSA Group also agrees that the camera survey data can be used to support best professional judgments on activities and exposure parameters (e.g., exposure frequency and fraction ingested). Once the data are compiled and analyzed, the Group will initiate further discussions with USEPA as to whether the data can be used quantitatively or qualitatively.

b. **SC#18 - exposure frequency for fish consumption:** In the referenced Burger (2002) study of fish/crab consumption in the Newark Bay Complex, it states that people who both fished and crabbed ate fish and crabs over six times a month, compared to four or fewer for others (those who only fished or crabbed). Six times a month over seven months, provides an upper-bound of 42 times per year for the RME. Since the Newark Bay Complex is inclusive of the BCSA, USEPA believes that 42 times per year is a reasonable maximum exposure frequency. A CTE of half the RME, or 21 times per year is acceptable. The utility of the camera survey has yet to be determined.

   Response: USEPA and the BCSA Group agreed previously to use an exposure frequency of 27 days for the RME and 15 for the CTE. The Agreement was codified in the BCSA Group's response letter to USEPA comments regarding the Memorandum of Human Exposure Scenarios and Assumptions, from Peter Brussock (ELM) to Doug Tomchuk (USEPA), dated February 12, 2010 (comment 18; hereafter MHESA comment response letter). The suitability of the agreed-upon exposure frequency was clearly described in the MHESA, page 16-17, and is based on region-specific data. Therefore, no revision is proposed to the draft PAR. Please refer to the response to comment 3a related to the camera survey.

c. **SC#24 - time spent fishing/crabbing:** USEPA suggested the use of 25% for the RME and 10% for the CTE based on best professional judgment as 25% direct contact with surface water while fishing/crabbing more accurately estimates a reasonable maximum exposure. The CTE value proposed remains acceptable to estimate average exposure via direct contact.

   Response: Comment noted. As stated in the response to comment 24 in the MHESA comment letter, the BHHRA will use 25% for the RME and 10% for the CTE for surface water contact frequency while fishing and crabbing.

d. **SC#32 - fraction ingested**: While USEPA agrees that it is unlikely for 100% of soil/sediment ingested in a day to originate from activities in the BCSA, until guidance is provided to evaluate a site-specific FI, the default of 1.0 should be used.

   Response: The use of the fraction ingested (FI) term in calculating incidental ingestion of sediment/soil intakes is identified by USEPA Guidance (1989)[1] as a pathway-specific value that should consider contaminant location and population activity patterns. The intent of the FI term is to provide a modifying factor to account for situations when the daily soil ingestion rate for an individual would not come exclusively from the contaminated area. Assuming an FI value of 1.0 would imply that all soil incidentally ingested during a daily exposure was from the contaminated area. The recreational exposure scenarios identified for the BCSA would represent only a fraction of a receptor's daily contact with soil and therefore it is reasonable to apply an FI term to account for that portion of the daily soil ingestion rate that occurs outside of the BCSA (e.g., at home, school or work).

   The BCSA Group is aware of precedent at several sites where USEPA has assumed a FI of less than 1.0 to account for the fraction of daily soil ingestion that occurs outside the contaminated area when evaluating recreational exposures. These include the GE-Housatonic River Site in Pittsfield, Massachusetts[2] (FI = 0.5), the Centerdale Manor Site in Rhode Island[3] (FI = 0.5), and the Cass Lake site in Minnesota[4] (FI = 0.3). The use of a FI value of 0.5 for the RME is both technically supportable and consistent with USEPA practice. Future risk assessment submittals will provide additional support for development of the FI term for use in the BCSA risk assessment.

4. The Remedial Investigation/Feasibility Study (RI/FS) Work Plan indicates that the PAR would include USEPA's RAGS Part D Table 1 (exposure pathways), Table 2 [contaminants of potential concern (COPCs)], Table 3 [exposure point concentrations (EPCs)], Table 5 (non-cancer toxicity data) and Table 6 (cancer toxicity data), but the

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[1] USEPA. 1989. Risk Assessment Guidance for Superfund. Part A.

[2] USEPA 1999. Memorandum form Ann-Marie Burke, toxicologist, to Richard Cabagnero, GE Project Leader, Re: Protectiveness of clean up levels for removal actions outside the river – protection of human health. Attachment A to Appendix D to Consent Decree.

[3] TetraTech. 2000. Final Engineering and Cost Evaluation Analysis. Centerdale Manner Restoration Project. USEPA Contract number 68-W6-0045.

[4] Integral Consulting. 2008. Addendum, human health and ecological risk assessment, St. Regis Paper Company site, Cass Lake, MN. May 30.

PAR would not include Table 4 (exposure factors and calculation equations). However, the PAR states that Table 4 will be presented in the future baseline human health risk assessment. Table 4 is also provided in the draft MHESA; however, subsequent correspondence (*i.e.*, MHESA response-to-comments) resulted in a number of changes to the exposure parameter values. A revised version of Table 4 should be included in the PAR since risk-based screening levels (RBSLs) were calculated in the PAR as an integral part of the COPC selection process and exposure parameters, and equations are needed to calculate RBSLs. (Note that currently, the exposure parameters can only be extracted from the RBSL online calculator input/output listing, which is included in the PAR as Attachment E.)

Response: The BCSA Group has updated the RAGS Tables 1 and 4 to reflect the current exposure assumptions for the HHRA. The updated tables are included as an attachment to this response to comments.

In addition, all exposure parameters used in the RBSL calculations are identified in Attachment E of the PAR, which should facilitate USEPA identification and review of the exposure factors used. Although the equations themselves are imbedded in the calculator and not presented in Attachment E, they are USEPA equations and therefore should not require additional USEPA review.

5. The USEPA online RBSL calculator database includes standard default values for various exposure parameters, such as contaminant intake rates, body weight, and life span. Based on the references cited for these default exposure parameters, some of the values included in the database may have been outdated. For instance, the 1997 "Exposure Factors Handbook" that provides many of the default exposure parameters was cited by the RBSL calculator user guide and apparently used for some of the inputs listed in Attachment E of the PAR, whereas USEPA has since released the "Child-Specific Exposure Factors Handbook" (September 2008) and "Exposure Factors Handbook: 2009 Update" (July 2009). It should also be noted that the November 2010 update to the USEPA RSL (or RBSL) Table is now available at the USEPA Region 3 website. It is suggested to update the inputs used for the RBSLs calculation to include the most current information.

   Response: All exposure parameters used in the RBSL calculation reflect site-specific conditions or, if default parameters were used, reflect the latest USEPA guidance at the time the draft PAR was prepared.

<u>Specific Comments</u>

6. **Page 2, Bullet "Fishing and crabbing recreational user" and Attachment E:** The PAR does not differentiate between exposures of fisher/crabber and recreational boater, though USEPA recommended different exposure frequencies for the two groups, 27 days for fishers/crabbers (MHESA comment 18) and 39 days for kayakers and canoers (MHESA comment 5). Please include a description of the fisher/crabber versus kayaker/canoer exposure pathways and justify the use of different EFs.

   Response: The draft PAR does differentiate between the fisher/crabber and recreational boater pathways, and applies different exposure frequencies for the two groups per USEPA's previous recommendation. These separate pathways are qualitatively described in the draft PAR on pages 2-3 (bullets 1 and 2) and RAGS Table 1, and the exposure parameters for the separate pathways are described in RAGS Table 4.

   As agreed at the meeting with USEPA on July 13, 2011, it is appropriate to use differing exposure factors for different exposure groups. The BCSA Group adopted the different exposure frequencies recommended by USEPA in the MHESA comments for the fishing/crabbing pathway (27 days) and kayaker/canoer pathway (39 days). Therefore, the approach in the draft PAR is appropriate and consistent with USEPA's recommendation. No change will be made.

7. **Pages 2 to 3, Fishing and crabbing recreational user:** "These may be local residents or visitors". In response to comment SC#9 in memo dated February 12, 2010, it was stated that, "The BHHRA will note that, like nearby residents, any local workers who fish and crab in the BCSA could take their catch home for consumption". Please include local workers in the group of fishers/crabbers.

   Response: This change will be made in subsequent risk assessment submittals.

8. **Page 3, Tide Gate Worker and Attachment E:** Ingestion rate and soil-to-skin adherence factors for tide gate workers have been set higher than that for a recreational adult (MHESA comment 10), but 5 days x 8 hours for 1 year seems too low an exposure rate for an employee who cleans multiple tide gates on a seasonal basis. Please define "multiple tide gates". Do these include tide gates within and outside of the BCSA? Please provide additional information on the tide gate workers (*e.g.*, how often the gates in BCSA are cleaned).

   Response: In response to this comment and the following two comments, the BCSA Group proposes to develop a single "construction worker" exposure scenario that will encompass tide-gate workers and other construction workers potentially engaging in intrusive (subsurface) activity, such as workers digging utility corridors or putting in bulkheads or bridges. The BCSA Group proposes to review the information on recent construction events in the area, such as the work at the Rutherford Tide Gate, and the rail line construction, to develop site-specific exposure assumptions regarding frequency and duration. These exposure assumptions will be included in subsequent risk assessment submittals, and can be discussed with USEPA prior to that if requested.

9. **Page 3, Tide gate worker:** Are two different tide gate worker scenarios proposed for evaluation? USEPA suggests evaluating the most conservative tide gate scenario and providing language in the BHHRA to illustrate that this is protective of other tide gate scenarios. Response to comment SC#10 in the February 12, 2010 memo states that the BHHRA will note that the West Riser Tide Gate is maintained by the Bergen County Mosquito Commission.

   Response: See response to specific comment #8. The BCSA Group will develop one construction worker scenario that will be protective of all construction workers, including tide-gate workers. As agreed with USEPA during our meeting on July 13, 2011, future risk assessment deliverables will note that that tide gate work can include both maintenance activities and tide gate replacement (construction) and that exposures to tide gate workers is potentially complete. Tide gate worker exposure will not be evaluated separately but will be included as part of the uncertainty evaluation of the range of worker exposure pathways.

10. **Page 3, future uses:** As agreed upon in the February 12, 2010 memo (GC#2), a construction/utility worker will be included as a receptor population. The construction/utility worker can be a future scenario with expected site-related activities to include bulkhead or bridge construction or underground utility installation.

    Response: See response to specific comment #8 and #9. The BCSA Group will develop one construction worker scenario that will be protective of all construction workers.

11. **Page 3, future uses:** Since groundwater in the area of BCSA is designated as Class II-A, it must be evaluated for potable use in a residential scenario. Since, currently, there is no known use of groundwater for drinking water purposes, it is sufficient to evaluate this pathway solely as a future use.

    Response:

    The scope of the RI/FS is focused on evaluating the surface water and sediment of the tidal waterways and marshes of the BCSA. Groundwater is not being addressed as part of this investigation, but rather is being addressed as a separate area of concern or operable unit as part of the management of upland sites.

    The marsh interstitial water is being evaluated as part of site characterization but the interstitial water is limited to a thin layer of marsh sediment and is brackish (greater than 3.5 ppt) due to the strong tidal influence on the marshes. Also, these sediments are not capable of transmitting water to a pumping well in usable and economic quantities and therefore unsuitable for any potable use. The Pleistocene clays (aquitard) that underlie the waterways and marshes effectively separate the marsh and waterway sediment deposits from the glacial till aquifer (Carswell, 1976), which is not part of the BCSA RI/FS.

12. **Page 6, Bullet "Fish and blue crab – ingestion" and Attachment E:** Attachment E presents screening values for fish consumption, but not for crab consumption. The title of the RBSL tables should be modified from "Fish Risk-Based Screening Levels for Fish" to "Risk-based Screening Levels for Fish and Crab".

    Response: Agreed.

13. **Page 6, primary exposure media:** Are bank soils included in the sediment classification?

    Response: Yes. In the context of the human exposure pathways proposed for evaluation, sediment and bank soil are considered to be comparable.

14. **Page 7, 1st paragraph:** While USEPA has not developed human health risk-based screening levels for chemicals in sediments; it is common practice to apply residential soil screening levels to the sediments. USEPA recognizes that these screening levels would be very conservative for use at the BCSA. On a site-specific basis, USEPA is willing to review site-specific screening levels, calculated using the USEPA Regional Screening Level calculator tool; however, we ask that one screening level per medium for all populations and ages be calculated. RAGS Table 4s will need to be provided so that we can more readily review the defaults that have been selected. USEPA is also willing to review the site specific screening level calculation for dermal contact with surface water, with accompanying Table 4s. USEPA requests that all screens be divided by a factor of ten to build a degree of conservatism back into the site-specific screening level.

    Response: There are several points raised in this comment.

    - **USEPA requests one RBSL per medium**. The draft PAR did utilize a single RBSL per medium to screen chemical data. The RBSL utilized was the lowest calculated RBSL for carcinogenic and non-carcinogenic responses across all receptors.
    - **USEPA requests that RAGS Table 4 be provided to support review of the assumptions used to calculate RBSLs.** See response to General Comment #4.
    - **USEPA will review dermal-based RBSLs, if provided.** As described in the draft PAR (page 11), dermal surface water exposures from the RBSL calculation is not a significant or important source of uncertainty in the PAR. Therefore, the

BCSA Group does not propose to calculate dermal-based RBSLs for surface water.

- **USEPA requests that all screens build in an extra factor of 10 to make the site-specific RBSLs more conservative.** The approach used to generate the RBSLs is consistent with USEPA guidance[5] for RBSL development. The RBSLs for noncarcinogenic effects presented in the draft PAR were derived by setting the target HQ to 0.1, which is an *option* (though not requirement) for sites with multiple contaminants, as noted in USEPA's RBSL guidance (USEPA, 2012). Also, as noted in that same guidance, cancer-based RBSLs are already calculated at 10^{-6} which is the low end of the USEPA's target risk range (i.e., 10^{-4} to 10^{-6} as set forth in USEPA 1990[6]) and it is not necessary to adjust further to account for multiple chemical exposure.

15. **Page 7, second bullet:** While this approach sounds reasonable, USEPA would again ask that the appropriate Table 4s be provided to determine what exposure parameters were selected. USEPA requests that all screens be divided by a factor of ten to build a degree of conservatism back into the site-specific screening level.

    Response: See response to General Comment 4.

16. **Page 7, third bullet:** Again, please provide the accompanying Table 4s for ease of review of exposure parameters. USEPA requests that all screens be divided by a factor of ten to build a degree of conservatism back into the site-specific screening level.

    Response: See response to General Comment 4.

17. **Page 7, Paragraph 2 (below bullets) and Attachment E:** It is noted that USEPA also suggested a higher RME exposure frequency of 39 days for kayakers and canoers (MHESA comment 5). A recreational user exposure frequency of 39 days should be used in Attachment E to generate risk-based screening levels. Page 8, first bullet, last sentence: "Points accessible" should include those accessible from land and from waterways.

    Response: See response to General Comment #4 and Specific Comment #6.

18. **Page 9, first bullet:** "Because potential exposure to surface sediments will be greater for recreational users than to intermittently exposed tide-gate workers, worker exposures in

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[5] USEPA. 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

[6] USEPA. 1990 National Oil and Hazardous Substances Pollution Contingency Program. 40 CFR 300.

the West Riser tide gate will not be separately quantified." Will a recreational user be evaluated with exposure to surface sediments in the West Riser tide gate area? While this area was recently excavated, we should confirm that contaminated sediments have not begun to accumulate.

Response: Data from the West Riser Tide Gate Area will be included in the risk evaluation.

19. **Page 10, COPC selection:** "The full list of COPCs selected for the BHHRA in this draft PAR (were) based on a maximum concentration above RBSLs and background…" Background data is not acceptable to screen out COPCs. Background studies may be used in the remedial design phase.

    Response: The comparison to background concentration data has been used throughout the RI process to provide focus to the field investigations and data evaluations. The consideration of background in the draft PAR is consistent with USEPA guidance (USEPA, 1989) and with site-specific discussions with USEPA. In addition, the BCSA Group continues to analyze approximately 10% of the samples (biased to potential exposure points) for the full BCSA analyte list without regard to background contaminants. All of the RI data will be included in the baseline risk assessment.

20. **Page 11, Exposure Point Concentration Summary:** Please indicate that the most recent version of USEPA's ProUCL software was utilized (v. 4.00.05).

    Response: The version of Pro UCL software used (v. 4.00.05) was the most recent version available in October 2010.

21. **Page 11, Paragraph 2 and Attachment F:** The referenced paragraph states that USEPA's statistical software package ProUCL 4.0 was used in calculating the exposure point concentrations (EPCs) and the model output was provided in Attachment F, but there was no description of the software or why it was used for the analysis. One of the advantages of this statistical package is its ability to handle nondetected concentrations in the data sample without the need to replace them with half the detection limit (or some other approximation). On the other hand, ProUCL calculates the Upper Confidence Limit (UCL) using several statistical methods and recommends one of the calculated values, but the recommended value might not always be reasonable, especially if the data sample size is less than a specified minimum. A brief description of the software's strengths and limitations should be provided.

    Response: A brief description of the software's strengths and limitations will be provided in subsequent risk assessment submittals.

22. **Table 1, page 1:** For the current/future exposure to ambient air over surface water, SC#11 of the February 12, 2010 memo stated that "the BHHRA will include an exposure pathway for…inhalation exposures to volatilized mercury for receptors on the water or on

the banks of the BCSA." That said, in addition to the recreational user (assumed fishing and crabbing), the tide gate worker/volunteer, and kayaker/canoer should also be evaluated.

Response: Inhalation exposures will be evaluated for recreational users (fishing, crabbing and kayaker/canoer), and construction workers. Please refer to the response to Specific Comment #9 related to tide gate workers.

23. **Table 1, page 2:** Exposure to whole body finfish should be evaluated in addition to the fillet as it is not uncommon for the entire body of a smaller fish to be used in a soup or stew.

    Response: As noted in USEPA guidance[7], most anglers in the United States consume fish fillets. Consequently, USEPA recommends that contaminant concentrations in fish be measured using skin-on fillets for scaled fish species, and that these data be used to assess potential human exposures (USEPA, 1989; USEPA, 2000). This is the approach used for the BCSA, is the approach commonly applied in evaluations of recreational fishing scenarios, and is the approach recommended by USEPA when using fish tissue to assess remedy effectiveness.[8] Although USEPA guidance (USEPA, 2000) does note that in certain situations whole fish may be consumed by humans, these situations are very specific, such as when there are subsistence populations in the area. There is no evidence that a subsistence population exists in the BCSA. Based on the camera data collected to date as well as observations by field crews present at the site during the RI/FS, fishing in the area is sporadic and recreational. Further, the BCSA Group is not aware of any other data indicating ingestion of whole perch or mummichog by persons in the BCSA. Given USEPA guidance, common risk assessment practice, and site-specific knowledge on the angler population, the BCSA Group maintains that fillet data are most appropriate for evaluating human health risks from fish consumption.

    As discussed and agreed with USEPA during our July 13, 2011 meeting, the fish that occur in the BCSA may not be consumed by humans at all given their typically small size, and are more likely to be used as bait fish. The uncertainty section of the baseline risk assessment will discuss the risk consequences of this assumption.

24. **Table 1, page 2:** Future exposure to groundwater as a residential drinking water source should also be evaluated since the aquifer in the area of BSCA is classified as II-A.

    Response: See response to Specific Comment #11.

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[7] USEPA. 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume II. http://water.USEPA.gov/scitech/swguidance/fishshellfish/techguidance/risk/volume2_index.cfm

[8] USEPA. 2008. Using Fish Tissue Data to Monitor Remedy Effectiveness. http://www.USEPA.gov/superfund/health/conmedia/sediment/pdfs/fish_sams.pdf

25. **Table 2:** Only metals and PCBs are included in the Table 2s. Where are the PAHs, pesticides and dioxins/furans?

    Response: The draft PAR evaluated the primary and secondary COPCs as identified in the Phase 1 Report. The constituents identified in the comment were not selected as COPCs and therefore were not included in the PAR; clarifying text will be included in the risk assessment. In addition, the BCSA Group continues to analyze approximately 10% of samples (biased to potential exposure points) for the full BCSA analyte list, and all of the RI data will be included in the baseline risk assessment.

26. **Table 2s:** Screening was done using the total chromium, rather than the more conservative, hexavalent chromium. As a secondary contaminant, it is important to know its dominant form (recognizing that it would be surprising to find high concentrations of Cr(6+) in the Berry's Creek environment). Please indicate where information regarding chromium speciation is available, or screen against Cr(6+) to be conservative.

    Response: Based on the geochemical behavior of chromium, chromium in the BCSA will be in the trivalent form (Cr^{3+}), as discussed below. Several analytes measured in the BCSA can serve as useful geochemical indicators for elucidating the electrochemical state of chromium in the study area. Based on our assessment of these indicators as discussed below, the BCSA Group has concluded that chromium exists predominantly in the reduced (trivalent) state, both in the aqueous and solid phases. One of the most reliable indicators for redox conditions is the high concentration of dissolved iron, which occurs in samples where chromium also was detected. Because compounds containing oxidized iron (Fe^{3+}) tend to be quite insoluble and reduced iron compounds (Fe^{2+}) tend to be much more soluble (Appelo and Postma, 1993)[9], detection of dissolved iron above roughly 100 μg/L often indicates that the environment is reducing to chromium and certain other metals. More quantitatively, because the standard reduction potential for the Fe^{3+}/Fe^{2+} couple (0.771 V; *CRC Handbook*)[10] is more negative than the corresponding potential for the Cr^{6+}/Cr^{3+} couple (1.35 V; *CRC Handbook*), then ferrous iron will reduce chromium from the hexavalent state to the trivalent state. The calculation can be refined by accounting for hydrolysis reactions that occur at higher pH (Baes and Mesmer, 1976)[11], but the general result that trivalent chromium persists over the hexavalent state is unchanged.

    That dissolved iron was measured at concentrations up to 13.4 mg/L at this site confirms that there is substantial ferrous (soluble) iron in the system. Moreover, because the overall abundance of iron is significant (comprising up to 5% by weight of acid-soluble matter in surface sediment), there is sufficient iron in the system to maintain chromium in

[9] Appelo, C.A.J., and Postma, D., 1993, Geochemistry, groundwater and pollution: Rotterdam, A.A. Balkema, 536p.
[10] *CRC Handbook of Chemistry and Physics,* 81st ed. Lide, D.R., Ed.; CRC Press: Boca Raton, FL, 2000.
[11] C. F. Baes, and R. E. Mesmer. 1976. *The Hydrolysis of Cations.* John Wiley & Sons, New York.

its reduced form indefinitely, providing geochemical conditions are not drastically altered. Other indicators that chromium is prevalent in its reduced state include the presence of soluble manganese and acid volatile sulfides (AVS). Manganese concentrations range up to 2 mg/L in the dissolved phase, which suggests that the predominant oxidation state is Mn^{2+}. The electrochemical considerations for manganese are the same as those discussed above for iron, namely that Mn^{2+} will reduce chromium from its hexavalent state to the trivalent state. Finally, the presence of AVS indicates that microbiological activity in the study area favors reducing conditions over oxidizing conditions. Although chromium does not tend to form compounds with either sulfate or sulfide, the presence of the latter is a strong indicator that trivalent chromium is favored over the hexavalent state. Therefore, it was deemed appropriate to screen against criteria for total chromium, which includes the assumption that the chromium present is largely in the trivalent form. The above discussion will also be included in the risk assessment.

27. **Table 2.2:** Lead should have a 'Y' COPC flag with a 'B' rationale.

    Response: Comment noted.

28. **Table 3.1:** If a sediment EPC will be calculated for each segment of the BCSA, then separate Tables 2s for each segment should be provided as well.

    Response: The COPC screening in the PAR was conducted using the maximum detected concentration in any reach, and in that way was conservative in the COPC selection. Although the BHHRA will evaluate reach-specific risks as well as BCSA-wide risks, the BCSA Group believes a consistent COPC list across all reaches will help characterize risks for the site and also support risk analysis of remedial alternatives.

Table 1 Initial Selection of Exposure Pathways
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 1

Scenario Timeframe	Medium [a]	Exposure Medium [b]	Exposure Point [c]	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Sediment	Sediment	Bank/Near-shore Sediment (Waterways, all study segments)	Recreational User (Fishing & crabbing)	Adult Older Child (6-18)	Ingestion	Quantitative	Recreational users may incidentally ingest particles of bank or near-shore sediment while fishing or crabbing. Contact with bank/near-shore sediments less likely in BCC (which has less exposed shoreline) and in UBC, where recreational use is less likely due to shallow waters, compared to other study segments.
						Dermal Contact	Quantitative	Recreational users may come into contact with bank or near-shore sediment while fishing or crabbing.
				Kayaker/Canoer	Adult Older Child (6-18)	Ingestion	Quantitative	Kayakers or canoers may incidentally ingest particles of near-shore sediment while recreating in the area. Contact with near-shore sediments less likely in BCC and UBC for reasons noted above.
						Dermal Contact	Quantitative	Kayakers or canoers may come into contact with near-shore sediment while recreating. Contact with mudflat sediments less likely in BCC and UBC for reasons noted above.
			Waterway Sediment (All study segments, subsurface and surface)	Worker	Adult	Ingestion	Quantitative	Workers may be involved in construction or maintenance activities that result in direct contact with waterway sediments.
						Dermal Contact	Quantitative	Workers may be involved in construction or maintenance activities that result in direct contact with waterway sediments.
			Marsh Surface Sediment (@ water access points)	Recreational User (Fishing & crabbing)	Adult Older Child (6-18)	Ingestion	Quantitative	Recreational users may incidentally ingest sediment particles from the marsh surface that are contacted while they are walking to waterway access points. Given the short duration and nature of the event, and the fact that detritus covers most of marsh sediment, exposures will likely be minimal.
						Dermal Contact	Quantitative	Recreational users may come into contact with sediment from the marsh surface while they are walking to the waterway access points. Given the short duration and nature of the event, and the fact that detritus covers most of marsh sediment, exposures will likely be minimal.
	Surface Water	Surface Water	Surface Water (Waterways, all study segments)	Recreational User (Fishing & crabbing)	Adult Older Child (6-18)	Dermal Contact	Quantitative	Recreational user may contact surface water while fishing or crabbing.
						Ingestion	Qualitative	Surface water is not potable and the recreational user is not expected to engage in swimming activity or use the site water as a source of drinking water.
				Kayaker/Canoer	Adult Older Child (6-18)	Dermal Contact	Quantitative	An overboard kayaker/canoer will be evaluated.
						Ingestion	Qualitative	Surface water is not potable and the boater is not expected to engage in swimming activity or use the site water as a source of drinking water. Potential ingestion will likely be minimal because the exposure will be infrequent and of short duration.
				Worker	Adult	Dermal Contact	Qualitative	Workers may briefly contact surface water during construction or maintenance activities. This exposure will be evaluated qualitatively by using the adult recreational dermal contact exposure, which assumes a greater contact rate than the worker exposure.
						Ingestion	Qualitative	Workers may briefly contact surface water during construction or maintenance activities. Potential ingestion is likely to be minimal because of the infrequent and short duration of the exposure.
		Ambient Air	Ambient Air - Mercury Vapor (Waterways, all study segments)	Recreational User	Adult Older Child (6-	Inhalation	Quantitative	Receptors could inhale volatiles released to ambient air from surface water.
				Kayaker/Canoer	Adult Older Child (6-	Inhalation	Quantitative	Receptors could inhale volatiles released to ambient air from surface water.
				Worker	Adult	Inhalation	Quantitative	Receptors could inhale volatiles released to ambient air from surface water.

Table 1 Initial Selection of Exposure Pathways
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 1

Scenario Timeframe	Medium [a]	Exposure Medium [b]	Exposure Point [c]	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
	Surface Water & Sediment	Fish	Finfish - Fillets (Waterways, all study segments)	Recreational User	Adult Older Child (6-18) Younger Child (0-6)	Ingestion	Quantitative	Recreational angler is expected to consume some portion of catch. This exposure could occur in all study segments, however the species caught and consumed could vary given the variable salinity conditions throughout BCSA which could affect species presence and abundance. Adult anglers are assumed to bring home catch for children to consume.
				Worker	Adult	Ingestion	Qualitative	Local workers who fish are expected to consume some portion of catch. This exposure could occur in all study segments, however the species caught and consumed could vary given the variable salinity conditions throughout BCSA which could affect species presence and abundance. Adult recreational fish ingestion exposure will serve as surrogate for this receptor group.
		Shellfish	Blue Crab - Muscle Tissue & Hepatopancreas (Waterways, all study segments)	Recreational User	Adult Older Child (6-18) Younger Child (0-6)	Ingestion	Quantitative	Recreational angler is expected to consume some portion of catch. Crabs are potentially present in all study area segments, however, density could be less in UBC where low saline/freshwater conditions prevail. Exposures in this segment via this pathway could therefore be less than in other segments where crabs are more prevalent. Child resident may ingest some portion of adult crabber's catch.
				Worker	Adult	Ingestion	Qualitative	Local workers who crab are expected to consume some portion of catch. Crabs are potentially present in all study area segments, however, density could be less in UBC where low saline/freshwater conditions prevail. Exposures in this segment via this pathway could therefore be less than in other segments where crabs are more prevalent. Adult recreational shellfish ingestion exposure will serve as surrogate for this receptor group.
Future Only	Surface Water	Surface Water	Surface Water (Waterways, all study segments)	Swimmer	Adult Older Child (6-	Dermal Contact Ingestion	Qualitative	Swimming not a current recreational activity in BCSA waterways. Future exposures will be evaluated qualitatively based on the current use Kayaker/Canoer exposure.
	Sediment	Sediment	Marsh Surface Sediment (@ future recreational area)	Recreational User	Adult Older Child (6-18)	Dermal Contact Ingestion	Qualitative	Future recreational improvements to BCSA could allow receptors to contact march sediments beyond the existing waterway access areas evaluated for this receptor group under the current land use scenarios. Future exposures will be evaluated qualitatively based on the current use evaluation.

Notes

[a] Defined by USEPA as the substance that is a potential source of contaminants in the Exposure Medium (the Medium will sometimes equal the Exposure Medium) (USEPA 2001). Herein equal to the Source Medium.

[b] Defined by USEPA as the contaminated environmental medium to which an individual may be exposed. This includes the transfer of contaminants from one Medium to another (USEPA 2001).

[c] Defined by USEPA as an exact location of potential contact between a person and a chemical within an Exposure Medium (USEPA 2001).

Table 4.1 Values used for Daily Intake Calculations
Fish Ingestion: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment/Surface Water
Exposure Medium:	Fish Tissue

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Fish Tissue	Cf	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Cf x IRf x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRf	Ingestion Rate of Fish Tissue	17.4	g/day	USEPA 2002, Section 5.1.1.1, Table 4	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (Age 6 - 18)	Fish Tissue	Cf	Chemical Concentration in Fish	TBD	mg/g		CDI (mg/kg-day) = Cf x IRf x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRf	Ingestion Rate of Fish Tissue	11.6	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
		Younger Child (Age 0 - 6)	Fish Tissue	Cf	Chemical Concentration in Fish	TBD	mg/g		CDI (mg/kg-day) = Cf x IRf x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRf	Ingestion Rate of Fish Tissue	5.8	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	6	years	USEPA 1989	
				BW	Body Weight	18.8	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	2,190	days	USEPA 1989	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

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Table 4.2 Values used for Daily Intake Calculations
Fish Ingestion: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment/Surface Water
Exposure Medium:	Fish Tissue

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Fish Tissue	Cf	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Cf x IRf x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRf	Ingestion Rate of Fish Tissue	7.5	g/day	USEPA 2002, Section 5.1.1.1, Table 4	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (Age 6 - 18)	Fish Tissue	Cf	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Cf x IRf x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRf	Ingestion Rate of Fish Tissue	5.0	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
		Younger Child (Age 0 - 6)	Fish Tissue	Cf	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Cf x IRf x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRf	Ingestion Rate of Fish Tissue	2.5	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	15	days/year	Basis for Ingestion Rate	
				ED	Exposure Duration	2	years	USEPA 1989	
				BW	Body Weight	18.8	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	730	days	USEPA 1989	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

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Table 4.3 Values used for Daily Intake Calculations
Shellfish Ingestion: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment/Surface Water
Exposure Medium:	Shellfish Tissue

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Shellfish Tissue (Blue Crab)	Csh	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Csh x IRsh x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRsh	Ingestion Rate of Crab Tissue	17.4	g/day	USEPA 2002, Section 5.1.1.1, Table 4	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (Age 6 - 18)	Shellfish Tissue (Blue Crab)	Csh	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Csh x IRsh x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRsh	Ingestion Rate of Crab Tissue	11.6	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
		Younger Child (Age 0 - 6)	Shellfish Tissue (Blue Crab)	Csh	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Csh x IRsh x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRsh	Ingestion Rate of Crab Tissue	5.8	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	6	years	USEPA 1989	
				BW	Body Weight	18.8	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	2,190	days	USEPA 1989	

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Table 4.4 Values used for Daily Intake Calculations
Shellfish Ingestion: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment/Surface Water
Exposure Medium:	Shellfish Tissue

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Shellfish Tissue (Blue Crab)	Csh	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Csh x IRsh x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRsh	Ingestion Rate of Crab Tissue	7.5	g/day	USEPA 2002, Section 5.1.1.1, Table 4	
				LOSS	Fraction Chemical Lost from Cooking	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (Age 6 - 18)	Shellfish Tissue (Blue Crab)	Csh	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Csh x IRsh x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRsh	Ingestion Rate of Crab Tissue	5.0	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from Cooking	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
		Younger Child (Age 0 - 6)	Shellfish Tissue (Blue Crab)	Csh	Chemical Concentration in Fish	TBD	mg/g	Site-specific	CDI (mg/kg-day) = Csh x IRsh x (1-LOSS) x FI x EF x ED x 1/BW x 1/AT
				IRsh	Ingestion Rate of Crab Tissue	2.5	g/day	BW Adjusted Adult Value	
				LOSS	Fraction Chemical Lost from Cooking	TBD	unitless	Chemical-specific, Default of 0	
				FI	Fraction Ingested from Source	TBD	unitless		
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	2	years	USEPA 1989	
				BW	Body Weight	18.8	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	730	days	USEPA 1989	

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Table 4.5 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	100	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	200	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
	Worker	Adult	Waterway Sediment (All study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	330	mg/day	USEPA 2002	
				FI	Fraction Ingested	1	--	Site-specific	
				EF	Exposure Frequency	40	days/year	Site-specific, assuming 8 weeks of work, at 5 days per week	
				ED	Exposure Duration	1	year	USEPA 2002	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	365	days	USEPA 1989	

Table 4.5 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Recreational User	Adult	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	100	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	200	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
	Recreational User	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	

Table 4.5 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
	Worker	Adult	Waterway Sediment (All study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,300	cm^2	USEPA 2002	
				AF	Soil to Skin Adherence Factor	0.3	mg/cm^2-event	USEPA 2002	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2002	
				EF	Exposure Frequency	40	days/year	Assumes activities last for 8 weeks at 5 days per week	
				ED	Exposure Duration	1	years	USEPA 2002	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	365	days	USEPA 1989	
		Adult	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	

Table 4.5 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Recreational User			ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	

References:

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Table 4.6 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Recreational User	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
	Worker	Adult	Waterway Sediment (All study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	330	mg/day	USEPA 2002	
				FI	Fraction Ingested	1	--	Assumed	
				EF	Exposure Frequency	10	days/year	Assumes activities last for two weeks at 5 days per week	
				ED	Exposure Duration	1	years	USEPA 2002	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	365	days	USEPA 1989	

Table 4.6 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Recreational User	Adult	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
	Recreational User	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	

Table 4.6 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
	Worker	Adult	Waterway Sediment (All study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,300	cm^2	USEPA 2002	
				AF	Soil to Skin Adherence Factor	0.3	mg/cm^2-event	USEPA 2002	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	10	days/year	Assumes activities last for two weeks at 5 days per week	
				ED	Exposure Duration	1	years	USEPA 2002	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	365	days	USEPA 1989	
	Recreational User	Adult	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	

Table 4.6 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
		Older Child (6-18)	Marsh Surface Sediment (@ water access points)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	

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Table 4.7 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Currrent
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Kayaker/Canoer	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	100	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	18	days/year	Assumes 2 events per month from spring through fall	
				ED	Exposure Duration	30	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	200	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	18	days/year	Assumes 2 events per month from spring through fall	
				ED	Exposure Duration	12	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
		Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	18	days/year	Assumes 2 events per month from spring through fall	

Table 4.7 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Currrent
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal	Kayaker/Canoer			ED	Exposure Duration	30	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	18	days/year	Assumes 2 events per month from spring through fall	
				ED	Exposure Duration	12	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	

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Table 4.8 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Kayaker/Canoer	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	9	days/year	Assumes 1 event per month from spring through fall	
				ED	Exposure Duration	9	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	9	days/year	Assumes 1 event per month from spring through fall	
				ED	Exposure Duration	4	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
		Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	9	days/year	Assumes 1 event per month from spring through fall	
				ED	Exposure Duration	9	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	

Table 4.8 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal	Kayaker/Canoer			ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	9	days/year	Assumes 1 event per month from spring through fall	
				ED	Exposure Duration	4	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	

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Table 4.9 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Kayaker/Canoer	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	100	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	39	days/year	Assumes 1 event per week from spring through fall.	
				ED	Exposure Duration	30	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	200	mg/day	USEPA 1991	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	39	days/year	Assumes 1 event per week from spring through fall.	
				ED	Exposure Duration	12	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
Dermal	Kayaker/Canoer	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	39	days/year	Assumes 1 event per week from spring through fall.	
				ED	Exposure Duration	30	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	

Table 4.9 Values used for Daily Intake Calculations
Sediment Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	39	days/year	Assumes 1 event per week from spring through fall.	
				ED	Exposure Duration	12	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	

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Table 4.10 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Ingestion	Kayaker/Canoer	Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	19	days/year	Assumes 1 event every other week from srping through fall	
				ED	Exposure Duration	9	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	CDI(mg/kg-day) = Cs × IRs × FI × EF x ED x CF1 x 1/BW x 1/AT
				IRs	Ingestion Rate of Sediment	50	mg/day	USEPA 2011	
				FI	Fraction Ingested	0.5	--	Site-specific, assuming one-half of daily soil ingestion amount is site sediment	
				EF	Exposure Frequency	19	days/year	Assumes 1 event every other week from srping through fall	
				ED	Exposure Duration	4	years	USEPA 1989	
				CF1	Conversion Factor	1.00E-06	kg/mg		
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
		Adult	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	4,860	cm^2	USEPA 2004 (Male only forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.07	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	19	days/year	Assumes 1 event every other week from srping through fall	
				ED	Exposure Duration	9	years	USEPA 1989	
				BW	Body Weight	70	kg	USEPA 1991	

Table 4.10 Values used for Daily Intake Calculations
Sediment Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Future
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal	Kayaker/Canoer			ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Bank/Near-shore Sediment (Waterways, all study segments)	Cs	Chemical Concentration in Sediment	TBD	mg/kg	Site-specific	Dermal Absorbed Dose (DAD) (mg/kg-day) = DA-event x EF x ED x EV x SA x 1/BW x 1/AT where Absorbed Dose per Event (DA-event)(mg/cm^2-event) = Cs x CF1 x AF x ABSd
				CF1	Conversion Factor	1.00E-06	kg/mg		
				SA	Skin Surface Area Available for Contact	3,097	cm^2	USEPA 2004 (Forearms, hands, lower legs)	
				AF	Soil to Skin Adherence Factor	0.2	mg/cm^2-event	USEPA 2004	
				ABSd	Dermal Absorption Factor	chemical-specific	unitless		
				EV	Event Frequency	1	events/day	USEPA 2004	
				EF	Exposure Frequency	19	days/year	Assumes 1 event every other week from srping through fall	
				ED	Exposure Duration	4	years	USEPA 1989	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	

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USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

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Table 4.11 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Recreational User	Adult	Surface Water	Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	2,300	cm^2	USEPA 2004 (Male only hands, forearms)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	
				t-event	Event Duration	2.4	hours/event	Assumes surface water contact for 25% of time spent angling	
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permebability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	30	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
				Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	1,632	cm^2	USEPA 2004 (Hands, forearms)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	

Table 4.11 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal Contact		Older Child (6-18)	Surface Water	t-event	Event Duration	2.4	hours/event	Assumes surface water contact for 25% of time spent angling	where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permeability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	27	days/year	Site-specific	
				ED	Exposure Duration	12	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	
				Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) =
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	20,200	cm^2	USEPA 2011 (Male only total body)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	
				t-event	Event Duration	0.25	hours/event	Best Professional Judgment	

Table 4.11 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Kayaker/Canoer	Adult	Surface Water	B	Ratio of permeability coefficient of chemical through stratum corneum relative to permebability coefficient across the epidermis	Chemical-specific	--	--	2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	18	days/year	Assumes boater goes overboard two times per month from spring through fall	
				ED	Exposure Duration	30	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	10,950	days	USEPA 1989	
		Older Child (6-18)	Surface Water	Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	14,500	cm^2	USEPA 2011 (Total body)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	
				t-event	Event Duration	0.25	hours/event	Best Professional Judgment	
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permebability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	

Table 4.11 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
				EF	Exposure Frequency	18	days/year	Assumes boater goes overboard two times per month from spring through fall	event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				ED	Exposure Duration	12	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	4,380	days	USEPA 1989	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

USEPA. 1991. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual. Supplemental guidance - "Standard default exposure factors". PB91-921314. OSWER Directive: 9285.6-03. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/pdf/oswer_directive_9285_6-03.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. March 25. 28 pp.

USEPA. 2004. Risk assessment guidance for Superfund: Volume 1 - Human health evaluation manual (Part E, Supplemental guidance for dermal risk assessment). Final. EPA/540/R/99/005. OSWER 9285.7-02EP. PB99-963312. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation, Washington, DC. July. 186 pp.

USEPA. 2011. Exposure factors handbook: 2011 edition. EPA/600/R-09/052F. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment. September.

Table 4.12 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Recreational User	Adult	Surface Water	Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	2,300	cm^2	USEPA 2004 (Male only hands, forearms)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	
				t-event	Event Duration	0.4	hours/event	Assumes surface water contact for 10% of time spent angling	
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permebability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	9	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
				Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	1,632	cm^2	USEPA 2004 (Hands, forearms)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	

Table 4.12 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Dermal Contact		Older Child (6-18)	Surface Water	t-event	Event Duration	0.4	hours/event	Assumes surface water contact for 10% of time spent angling	where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permeability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	15	days/year	Site-specific	
				ED	Exposure Duration	4	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	
		Adult	Surface Water	Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	20,200	cm^2	USEPA 2011 (Male only total body)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	
				t-event	Event Duration	0.08	hours/event	Best Professional Judgment	
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permeability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	9	days/year	Assumes boater goes overboard once per month from spring through fall	

Table 4.12 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
	Kayaker/Canoer			ED	Exposure Duration	9	years	USEPA 1989	where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	70	kg	USEPA 1991	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	3,285	days	USEPA 1989	
		Older Child (6-18)	Surface Water	Cw	Chemical Concentration in Surface Water	TBD	mg/l	Site-specific	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA-event x EV x ED x EF x SA x 1/BW x 1/AT where for organic compounds, Absorbed Dose per Event (DA-event) (mg/cm^2-event) = 2 FA x Kp x Cw x CF2 x SQRT ((6 x tau-event x t-event)/pi) or DA-event = FA x Kp x Cw x (t-event(1+B)) + 2 x tau-event x ((1+(3 x B) + (3 x B x B))/(1 + B)2)) and where for inorganic compounds, DA-event = Kp x Cw x CF2 x t-event
				FA	Fraction Absorbed Water	Chemical-specific	--	--	
				Kp	Permeability Constant	Chemical-specific	cm/hr	--	
				SA	Skin Surface Area	14,500	cm^2	USEPA 2011 (Total body)	
				tau-event	Lag time per event	Chemical-specific	hours/event	--	
				t-event	Event Duration	0.08	hours/event	Best Professional Judgment	
				B	Ratio of permeability coefficient of chemical through stratum corneum relative to permebability coefficient across the epidermis	Chemical-specific	--	--	
				EV	Event Frequency	1	events/day	USEPA 1989	
				EF	Exposure Frequency	9	days/year	Assumes boater goes overboard once per month from spring through fall	
				ED	Exposure Duration	4	years	USEPA 1989	
				CF2	Volumetric Conversion Factor for Water	0.001	L/cm^3	--	
				BW	Body Weight	52.2	kg	USEPA 2011	
				ATc	Averaging Time - Cancer	25,550	days	USEPA 1989	
				ATnc	Averaging Time - Noncancer	1,460	days	USEPA 1989	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

Table 4.12 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe:	Current/Future
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name

USEPA. 1991. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual. Supplemental guidance - "Standard default exposure factors". PB91-921314. OSWER Directive: 9285.6-03. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/pdf/oswer_directive_9285_6-03.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. March 25. 28 pp.

USEPA. 2004. Risk assessment guidance for Superfund: Volume 1 - Human health evaluation manual (Part E, Supplemental guidance for dermal risk assessment). Final. EPA/540/R/99/005. OSWER 9285.7-02EP. PB99-963312. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation, Washington, DC. July. 186 pp.

USEPA. 2011. Exposure factors handbook: 2011 edition. EPA/600/R-09/052F. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment. September.

Table 4.13 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	9.5	hours/day	USEPA 1997	
				EF	Exposure Frequency	27	days/yr	Site-specific	
				ED	Exposure Duration	30	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	10,950	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
		Older child (6-18)	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	9.5	hours/day	USEPA 1997	
				EF	Exposure Frequency	27	days/yr	Site-specific	
				ED	Exposure Duration	12	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	4,380	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
	Worker	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	8	hours/day	USEPA 2002	
				EF	Exposure Frequency	40	days/yr	Assumes activities take two months to complete	
				ED	Exposure Duration	1	yrs	USEPA 2002	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	365	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

USEPA. 1997. Exposure factors handbook. Final. EPA/600/P-95/002Fa,b,c. U.S. Environmental Protection Agency, Office of Health and Environmental Assessment, Washington, DC. August. 1193 pp.

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Table 4.14 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Inhalation	Recreational User	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	3.5	hours/day	USEPA 1997	
				EF	Exposure Frequency	15	days/yr	Site-specific	
				ED	Exposure Duration	9	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	3,285	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
		Older Child (6-18)	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	3.5	hours/day	USEPA 1997	
				EF	Exposure Frequency	15	days/yr	Site-specific	
				ED	Exposure Duration	4	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	1,460	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
	Worker	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	8	hours/day	USEPA 2002	
				EF	Exposure Frequency	10	days/yr	Assumes activities take two weeks to complete	
				ED	Exposure Duration	1	yrs	USEPA 2002	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	365	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 2011)	

Table 4.14 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

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USEPA. 2002. Supplemental guidance for developing soil screening levels for Superfund sites. OSWER 9355.4-24. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, DC. December.

USEPA. 2011. Exposure factors handbook: 2011 edition. EPA/600/R-09/052F. U.S. Environmental Protection Agency, Office of Research and Development, National Center for Environmental Assessment. September.

Table 4.15 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Current
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Inhalation	Kayaker/Canoer	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	4	hours/day	Site-specific	
				EF	Exposure Frequency	18	days/yr	Assumes 2 events per month for spring through fall months	
				ED	Exposure Duration	30	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	10,950	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
		Older Child (6-18)	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	4	hours/day	Site-specific	
				EF	Exposure Frequency	18	days/yr	Assumes 2 events per month for spring through fall months	
				ED	Exposure Duration	12	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	4,380	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	28,470	days	365 days x 78 yrs (USEPA 1989)	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

Table 4.16 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Current
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Inhalation	Kayaker/Canoer	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	2	hours/day	Site-specific	
				EF	Exposure Frequency	9	days/yr	Assumes 1 event per month for spring through fall months USEPA 1989	
				ED	Exposure Duration	9	yrs		
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	3,285	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
		Older Child (6-18)	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	2	hours/day	Site-specific	
				EF	Exposure Frequency	9	days/yr	Assumes 1 event per month for spring through fall months USEPA 1989	
				ED	Exposure Duration	4	yrs		
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	1,460	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	28,470	days	365 days x 70 yrs (USEPA 1989)	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

Table 4.17 Values used for Daily Intake Calculations
Surface Water Contact: Reasonable Maximum Exposure
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Inhalation	Kayaker/Canoer	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	4	hours/day	Site-specific	
				EF	Exposure Frequency	39	days/yr	Assumes 1 event per week for spring through fall months	
				ED	Exposure Duration	30	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	10,950	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
		Older Child (6-18)	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	4	hours/day	Site-specific	
				EF	Exposure Frequency	39	days/yr	Assumes 1 event per week for spring through fall months	
				ED	Exposure Duration	12	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	4,380	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

Table 4.18 Values used for Daily Intake Calculations
Surface Water Contact: Central Tendency
Berry's Creek Study Area
Risk Assessment Guidance for Superfund (RAGS) - Part D, Table 4

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/Reference	Intake Equation/ Model Name
Inhalation	Kayaker/Canoer	Adult	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	2	hours/day	Site-specific	
				EF	Exposure Frequency	19	days/yr	Asssumes event every other week during spring through fall months	
				ED	Exposure Duration	9	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	3,285	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	
		Older Child (6-18)	Volatiles Released from Surface Water to Ambient Air	C_A	Chemical Concentration in Air	Chemical-specific	mg/m^3	Site-specific	Exposure Concentration (mg/m^3) = CA x ET x EF x ED x CF x 1/AT
				ET	Exposure Time	2	hours/day	Site-specific	
				EF	Exposure Frequency	19	days/yr	Asssumes event every other week during spring through fall months	
				ED	Exposure Duration	4	yrs	USEPA 1989	
				CF	Conversion Factor	0.04	day/hours		
				AT_{nc}	Averaging Time (Noncancer)	1,460	days	ED x 365 days/yr (USEPA 1989)	
				AT_c	Averaging Time (Cancer)	25,550	days	365 days x 70 yrs (USEPA 1989)	

References:

USEPA. 1989. Risk assessment guidance for Superfund (RAGS). Volume I: Human health evaluation manual (Part A). EPA/540/1-89/002. Interim Final. Available at: http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, DC. December. 287 pp.

BCSA RESPONSE TO EPA COMMENTS DATED JULY 2, 2015 REGARDING THE MEMORANDUM ON HUMAN EXPOSURE SCENARIOS AND ASSUMPTIONS AND THE PATHWAYS ANALYSIS REPORT
August 27, 2015

The following are the Berry's Creek Study Area (BCSA or Site) Cooperating Parties Group (the Group) responses to the comments provided by the U.S. Environmental Protection Agency (EPA) on the *Memorandum on Human Exposure Scenarios and Assumptions* and the *Pathways Analysis Report* in a letter dated July 2, 2015.

The Group is proposing that we will not revise and reissue the subject reports, but instead will incorporate the agreed upon approaches and assumptions into the subsequent submittal of the baseline human health risk assessment (BHHRA) for the BCSA.

The Group's responses are presented below for each EPA comment in the July 2, 2015 letter.

MESA

1. ***Page 5: Human Use, 2nd paragraph - It is stated that white perch are typically in the range of 6 to 8 in. or less while New Jersey Fish and Wildlife considers edible fish to be in the 10 to 12 in. range. Ten inches equates to approximately 250 mm. The recent 2014 white perch age to length data indicate that 10-15% of the perch caught in the BCSA are considered to be of edible size.***

   Additionally, there will be a discussion in the Uncertainty section which qualitatively evaluates the consumption of fish in a stew in which size is of no consequence. Please make this clear in the text.

   RESPONSE: A more complete characterization of the size (i.e., length) of white perch found in the study area will be included in the BHHRA. The Uncertainty section of the BHHRA will also recognize that fish of smaller sizes may be consumed by individuals in more limited circumstances (e.g., in stews).

2. ***Page 8: Groundwater Use bullet - Please indicate that groundwater in the area is classified as II-B with a description of this designation. When did the groundwater get this designation rather than Class IIA?***

   RESPONSE: The area of site characterization in the BCSA is tidal with brackish surface water. Underlying groundwater can occur in a discontinuous thin veneer of Holocene fluvial deposits that are tidally inundated daily with brackish water. However, the dominant underlying unit is a massive glacial lake varved clay that is not a source of groundwater. The glacial clay deposit is in turn underlain by glacial till in some areas and by the Passaic bedrock formation, consisting of a reddish-brown shale, siltstone and mudstone with some conglomerate and sandstone beds.

Based on detailed review of the stratigraphy, permeability and regional geology (Carswell, 1976; NJGS, 1959), the ground water beneath the tidal portion of the BCSA is best described as a combination of (see Figure):

(1) Glacial Till and Passaic Formation - Class II-A – Consists of all ground water of the state that is potable or potable subsequent to conventional water treatment, except for ground water designated in Classes I, II, or III. As ground water flow from this unit is towards the tidal discharge area rather than from the tidal area, any contaminants associated with the surface water in the BCSA will not pose a risk to the Class II-A ground water, consistent with the conceptual site model presented in the Phase 2 Site Characterization Report. In addition, potable water in the BCSA and surrounding area is provided from a surface water source in the Passaic River Watershed. In relation to the comment, none of the area surrounding the BCSA has been reclassified as Class II-B to the knowledge of the BCSA Group.

(2) Massive Glacial Lake Deposit (varved clay) - Class III-A – Not suitable for potable water due to natural hydrologic characteristics which meet and exceeds the necessary characteristics for Class III-A designation (N.J.A.C 7:9C – 1.5 (f)1.:

i. Average at least 50 feet in thickness within the Class III-A;

ii. Have a hydraulic conductivity of approximately 0.1 ft/day or less in the Class III-A area; and

iii. Have an aerial extent with within the Class III-A area of at least 100 acres.

(3) Thin Fluvial Sediments and Marsh Deposits overlying the glacial lake deposit (see (2) above) – Class III–B – Not suitable for potable water due to the brackish nature of the surface water and associated interstitial water in the fluvial/marsh deposits. Class III-B applications have been approved for more localized areas within the BCSA, including the UOP Superfund Site and Matheson Tri Gas property.

With regard to the Class III designations, these have not been formally proposed to NJDEP but discussions have been initiated to consider the process needed to formally propose the designations.

<u>References:</u>

Carswell, L.D., 1976. Appraisal of Water Resources in the Hackensack River Basin, New Jersey; U.S. Geological Survey, Water-Resources Investigations 76-74.

NJGS, 1959. Bedrock Map of the Hackensack Meadows, Geologic Report Series No. 1, NJGS-NJDEP.

3. ***Page 10: Last paragraph - Based on the camera study, it was concluded that there is little evidence to suggest that the same person returns to the site to fish or crab. Due to issues such as camera resolution, EPA does not believe that this statement can be made with confidence. Please omit.***

   RESPONSE: The comment is noted. Future text discussions will indicate that the results of the camera survey cannot be used to determine definitively if individuals return to the Site more than once. No changes are required for the BHHRA exposure factors as the referenced statement was not considered in their development.

4. ***Page 11: 1st paragraph - EPA does not consider fishing advisories or other institutional controls in a Baseline Human Health Risk Assessment. There is no guarantee they will be in place indefinitely. Exposure assumptions should be made without consideration of such site use controls.***

   RESPONSE: The exposure assumptions were selected without consideration of institutional controls. No changes to the exposure assumptions will be made in response to this comment.

5. ***Page 15: 2nd full paragraph, surface water: the diver scenario we saw last year was not included.***

   RESPONSE: The BHHRA will recognize this diver as a receptor with associated exposure to surface water through dermal contact. A summary of EPA's analysis and findings of the diver scenario (completed in November 2014) will be provided. EPA's evaluation will be included as an attachment in the BHHRA. See also response to Comment #25.

6. ***Page 17: Exposure Duration, 1st paragraph, last sentence: The RME exposure duration for an adult is 8 years regardless of whether a young or older child scenario are evaluated as per reference USEPA 2014b. The ED for adults may be decreased from 14 to 8 years for all exposed populations.***

   RESPONSE: The ED for the adult kayaker will be assumed to be 8 years, as requested by EPA.

7. ***Page 19: Body Weight - Why use males for the older child angler/crabber but males and females for the older child kayaker/canoer? Please use males only for all scenarios to remain consistent and conservative (if ever so slightly) unless it doesn't make sense to do so.***

   RESPONSE: It is noted that the use of a larger male only body weight is less conservative when estimating a receptor's average daily dose for the ingestion pathway. For the BHHRA, it will be assumed that all receptor populations are composed of both males and females. Observations of activities at the Site confirm that recreators are comprised of males and females.

8. ***Page 19: Sediment Ingestion Rate - EPA has never agreed to adjust the fraction ingested and does not approve of this language being included in any risk document. It is Regional policy to not adjust this exposure factor. Please omit.***

   RESPONSE: The rationale referenced above will not be included in the BHHRA report. RME and CTE sediment ingestion rates of 100 mg/day and 20 mg/day respectively will be assumed for recreators. A fraction ingested value of 1 will be used for both RME and CTE estimates.

9. ***Page 23: 1st paragraph - While it is recognized that efforts to collect larger size white perch have been unsuccessful in the past, the effort in 2014 did collect fish of an edible size. Is this accounted for within this document? Inclusion of that information would be appropriate in this location.***

   RESPONSE: A complete characterization and consideration of the size of white perch collected during the various sampling efforts will be included in the BHHRA.

10. ***Page 24: Top of page - "24 oz." is likely a typo. Is it supposed to be "14 oz.?"***

    RESPONSE: 24 oz. will be corrected to 14 oz. in the description of the fish ingestion rates included in the BHHRA.

11. ***Page 25: Crab hepatopancreas - The mean percentage of hepatopancreas to total muscle tissue was selected based on an NJDEP study in Newark Bay. EPA requests that an upper bound estimate of the average be used instead.***

    RESPONSE: The NJDEP (2002) reference cited in the MESA reports only a mean percentage, and site-specific data to support the derivation of an upper bound estimate of the average hepatopancreas to total muscle tissue is not available. Use of the proposed value is consistent with USEPA's (1989) RAGS A which supports the use of some mean estimates in deriving RME exposures. The implications of using an average value for this parameter will be discussed in the Uncertainty section of the BHHRA. The BHHRA will continue to use the mean percentage of hepatopancreas to total muscle tissue of 19 percent.

12. ***Page 25: Cooking loss - EPA Region 2 does not support adjustment of contaminant concentration based on cooking loss. We assume that 100% of the contaminants present in tissue are available for consumption.***

    RESPONSE: The RME risk estimates will assume that 100 percent of the contaminants present in tissue are available for consumption. In line with other BHHRA's completed under Region 2 EPA, including those completed for the

Hudson River and Gowanus Canal, the CTE risk estimates will assume an alternative cooking loss assumption as supported by available scientific evidence.

References:

TAMS/Gradient. 2000. Phase 2 Report. Volume 2F. Revised Human Health Risk Assessment. Hudson River PCBs Reassessment RI/FS. TAMS Consultants and Gradient Corp.

HDR. 2011. Gowanus Canal Remedial Investigation Report. Volume 1. Appendix L. Human Health Risk Assessment. Draft. Prepared for U.S. Environmental Protection Agency. HDR, CH2M Hill, and GRB Environmental Services, Inc.

13. ***Table 1: How were values provided in the column entitled, "Estimated Potential for Direct Contact Time with BCSA Sediment or Water" determined? Please provide some explanation.***

    RESPONSE: The activities in Table 1 represent actual construction projects that have occurred in the BCSA between 2007 and 2014. During these general activities, the potential for direct sediment contact by the workers occurs only during some aspects of the project. Observations during these activities and knowledge about the overall scope of the project were used as the basis for conservative estimates of the time when a worker would directly contact sediment. As noted in footnote "b," actual contact with the sediment would be reduced by using boots, gloves, and other standard personal protective equipment.

14. ***RAGS Part D, Table 1: For the swimmer rationale it states, "Future exposures will be evaluated qualitatively based on the current use Kayaker/Canoer scenario". The future swimmer should have a greater skin surface area in contact with surface water, exposure time, etc. This is not a sufficient rationale.***

    RESPONSE: The BHHRA plans to evaluate this scenario in a qualitative manner using the risks estimated for the current and future kayaker/canoers. These kayakers/canoers are assumed to be exposed to surface water for 18 days/year (current) or 39 days/year (future) for 15 minutes per event. It is assumed that kayakers/canoers fall overboard with subsequent dermal exposure over the body's entire surface area, similar to a swimmer. Kayakers/canoers are also assumed to ingest surface water during the time overboard based on a rate suggested by USEPA (1989) for swimming scenarios. The exposure parameters for the future swimmer are envisioned to be consistent with those of the kayaker/canoer and therefore the use of the kayaker/canoer as the basis for the qualitative evaluation of the future swimmer is appropriate.

15. ***RAGS Part D, Table 1: The hiker in marsh rationale states, "Future exposures will be evaluated qualitatively based on the current use evaluation." However, there is no marsh hiker evaluated currently.***

    RESPONSE: As described in the MESA, future hikers in the marsh would use boardwalks or paths constructed as part of future recreational improvements to the BCSA. In these settings the primary exposure would be through inhalation of volatile chemicals and negligible contact with the surface sediments on the marsh surface, as such contact would likely require leaving the constructed path. As proposed, the future marsh hiker will be evaluated in a qualitative manner based on the risks estimated for other recreational receptors that have similar inhalation exposures along with greater contact with marsh sediments (i.e., angler/crabbers and kayaker/canoers).

16. ***Appendix C, page 2: Do the selected studies include those conducted for the SCP site? If not, please explain why not. The SCP documents seem to suggest that the varved clay layer is not as thick under that site, and that contamination from the SCP site has been found within the lodgement till. Please incorporate these findings into this discussion as appropriate. In addition, some contaminants have entered into the bedrock zone and their migration is influenced by pumping supply wells. Please clarify the statements that Berry's Creek groundwater migration is limited, when the SCP information is included in the analysis.***

    RESPONSE: Information from the investigations at the SCP site has now been included in the evaluation, specifically Golder, 2009. At SCP, the glaciolacustrine varved unit is 10-23 feet thick in the vicinity of Peach Island Creek and is overlain by approximately 8 feet of organic silt/ bedded clay so that the combined thickness of low permeability materials above the glacial till is 18-31 feet. Contamination is present in the glacial till as noted in the comment; however, local penetrations of the low permeability materials in the form of historic wells were present[1] and provided a contaminant migration pathway. Groundwater movement through the low permeability materials that underlie the waterways is very limited at SCP and throughout the region.

    [1] Identified wells were sealed as part of remedial activities.

17. ***Appendix C, page 2: Hydrogeological information (including test borings or wells) collected during the Berry's Creek study in the area of the known landfills should be included in this analysis.***

    RESPONSE: No wells or test borings were completed in the areas of known landfills as part of the RI. Several borings were attempted but hit refusal just below the surface due to large debris.

18. ***Appendix C, page 4, 1st full paragraph: The discussion of the location of the Class III-B Ground Water should include mention of the Universal Oil Products site.***

    RESPONSE: See Response to Comment #2.

19. ***Appendix C, page 4, Summary: Add the glacial/sandier lodgement till unit to this paragraph. It is a significant unit and is the most affected unit at the SCP site.***

    RESPONSE: The glacial till present at the SCP site (Rahway Till) has been divided into an upper soft till and a lower, over-consolidated Lodgement Till based on differing physical properties. This distinction may be present but has not been recorded in other studies within the BCSA.

20. ***Appendix C, page 5, last paragraph, 3rd sentence: Something seems to be missing from this sentence.***

    RESPONSE: "Ground water" was missing from the sentence. The sentence should read, "Within the BCSA, shallow ground water is recharged by rainfall-infiltration processes and discharges to area tidal creeks and marshes.

21. ***Appendix C, general: The data from the SCP site suggest that the clay unit is not completely impermeable to contaminant transport because site contamination has reached the lodgement till and the bedrock aquifer. Also note that groundwater in the bedrock aquifer is influenced by pumping industrial wells near SCP. This could alter whether EPA would require that groundwater be evaluated for a potable scenario in the future since it is classified as IIB.***

    RESPONSE: The glaciolacustrine unit at the SCP site has similar properties to that present in other parts of the BCSA. As noted in response to comment #16, the vertical migration of contamination was most likely associated with localized anthropogenic pathways. As noted in the comment, use of industrial wells can perturbate horizontal hydraulic gradients in the bedrock aquifer; however, the bedrock unit is not hydraulically connected to Berry's Creek. Groundwater movement through the low permeability materials that underlie the waterways is very limited at SCP and throughout the region.

Reference: Golder Associates Inc., 2009, Off-Property Groundwater Investigation Report, Operable Unit No. 3, 216 Paterson Plank Road Site, Carlstadt, NJ, July 2009.

PAR

22. ***Please describe how the PCB congener/dioxin TEQ be incorporated into the human health evaluation? There is no mention of it in the PAR.***

    RESPONSE: Non-cancer hazards and cancer risks from exposure to dioxin like PCB congeners will be evaluated using dioxin TEQs and presented within the uncertainty evaluation of the BHHRA. Non-cancer risks will be evaluated using EPA's RfD for 2,3,7,8-TCDD of 7 x 10^{-10} mg/kg-day. Cancer risks will be evaluated using the cancer slope factor developed by California's Office of Environmental Health Hazard Assessment (OEHHA) of 130,000 per mg/kg-day. The CSF from OEHHA is also adopted by EPA in their derivation of Regional Screening Levels (RSLs) for 2,3,7,8-TCDD.

23. ***Page 2, 3rd bullet: Bidirectional may be an oversimplification, since contaminants can also be transported laterally (e.g., the marshes).***

    RESPONSE: The term "bidirectional" will not be used to describe the potential movement of COPCs across the Site in the BHHRA. The potential for lateral transport will also be recognized.

24. ***Page 4, Future Swimmer, waterways: Please delete the word "primary" in this sentence.***

    RESPONSE: The term primary will not be used in the above referenced context in the BHHRA (e.g., "In particular, on the Hackensack River, there are at least 15 combined sewer outfalls and the **primary** treatment plant in Little Ferry releases untreated sewage during storm events").

25. ***Page 8, Surface Water: As per the comment on the MESA, we should discuss if the diver scenario (with heated surface water pumped inside the wetsuit) should be included in the risk assessment.***

    RESPONSE: The BHHRA will recognize the diver scenario. As noted in the response to Comment #5, a summary of EPA's analysis and findings of the diver scenario (completed in November 2014) will be provided. EPA's evaluation will be included as an attachment in the BHHRA.

26. ***Page 8, last paragraph: Please revise to read, "The lowered risk targets were requested by EPA to add an extra amount of conservatism in the COPC selection given that less-conservative, site-specific RBSLs were being used rather than default screening levels."***

    RESPONSE: The BHHRA text will include such a statement describing EPA's request to use the specific target risks applied in the screening.

27. ***Page 9, 2nd paragraph: How will lead be evaluated qualitatively in the BHHRA?***

RESPONSE: A COPC screening will be completed for lead in sediment in the BHHRA. The screening will compare mean lead concentrations to a back-calculated risk based level for Site receptors using the Adult Lead Methodology (ALM). The use of the mean (and not maximum) lead concentration for this proposed screening is in line with EPA's guidance on the use of average concentrations when evaluating risks from lead. If lead becomes a COPC we will evaluate it for the recreator and construction worker sediment direct contact scenarios using the ALM. Exposure parameters for the ALM will be selected to be consistent with those outlined for other COPCs (e.g., RAGS D Table 4 in the MESA) and EPA's guidance on lead risk assessment.

28. ***Page 10, l " paragraph: In soft sediments such as found in Berry's Creek, EPA prefers that a depth of contact for waders would be 15 cm (6 in.). This depth has been used at other sediment sites in the region as well.***

RESPONSE: For evaluating recreational scenarios, the BHHRA will use sediment data from 0 to 15 cm in soft waterway sediments when available. The majority of the surface sediment data collected from BCSA waterways is collected from the biologically active zone (BAZ) – either 0 to 6 cm in UBC or 0 to 10 cm in the other BCSA reaches – and does not extend to 15 cm. In a subset of locations, however, some cores are available that extend from the BAZ to 15 cm and data from these locations will be used in the risk assessment. Shallow BAZ samples (operationally defined in the RI as 0 to 2.5 cm) will not be used to estimate recreational exposures, however, because they represent a small portion of the sediment column to which recreators could potentially be exposed.

29. ***Page 10, Chemical-Specific Sampling Results Considered in PAR, Surface Water: Table 2.5 (Dissolved concentrations) should not be used to evaluate human exposures.***

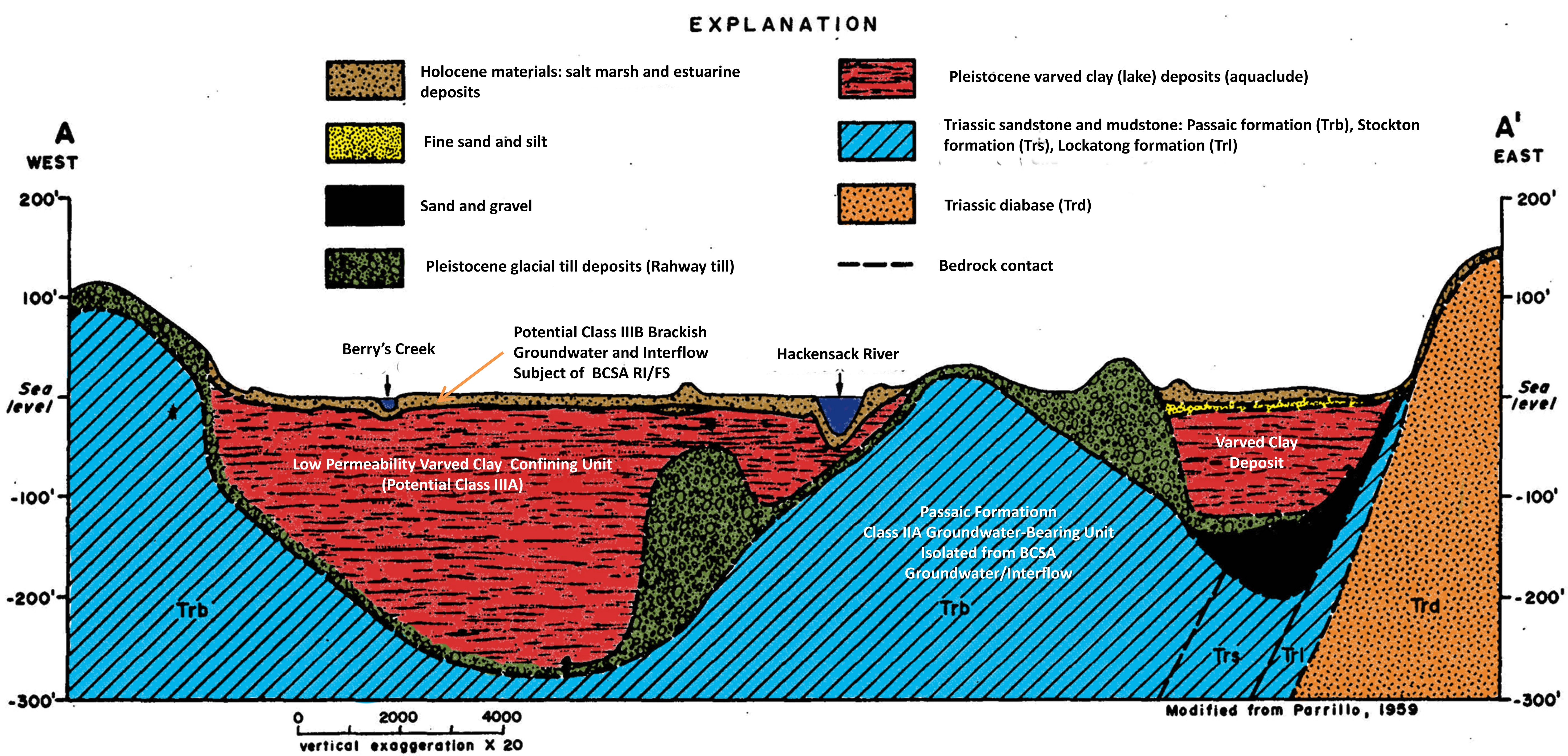
RESPONSE: The COPC screening will use total concentrations in surface water. The calculation of baseline risks in the BHHRA will also use the total concentrations in surface water. Due to the conservative nature of this approach for dermal exposures the BHHRA may include a second tier evaluation using dissolved concentrations for the dermal exposure pathway.

30. ***Page 10, Chemical-Specific Sampling Results Considered in PAR, Surface, Fish/Crab: Please clarify why it was determined that the exposure evaluation would be conducted by reach for fish, while it is being done site wide for crabs.***

RESPONSE: The BHHRA will calculate risks via crab consumption on a reach-specific basis. The RAGS D Table 2 series referenced in the comment present Site-wide data summaries for all media. The RAGS D Table 3 series present EPCs by media and reach.

31. ***Page 11, Exposure Point Concentration Summary: A concentration-toxicity screen was used to focus the PAR on contaminants that contribute most significantly to risk. In EPA RAGS Part A, there are many other factors to consider when proposing this approach, none of which were discussed in the PAR. From RAGS A: "The concentration-toxicity screen in particular may be needed only in rare instances." "Quantitative evaluation of all chemicals of potential concern is the most thorough approach in a risk assessment." It is EPA Regional policy to carry contaminants through the risk assessment and identify contaminants as not site-related (e.g., resulting from background contamination) in the risk characterization section. Also, the suggested ratio to use as per RAGS is 0.01 or lower, orders of magnitude below the suggested value of l0 in the Draft PAR. Since EPA has agreed to allow site-specific screening values to be developed for use at the site which are less conservative than default screening levels, an additional attempt to further screen out contaminants is not appropriate. As a result, this approach is not supported by EPA.***

    RESPONSE: The BHHRA will complete a screening on all detected chemicals. Any chemical with a maximum concentration that exceeds the selected Site-specific RBSL will be carried forward and evaluated in the BHHRA.



Notes:
Figure adapted from Carswell (1976).

DRAFT

Geologic Cross Section and Groundwater-Bearing Units

Appendix D
Urban Hydrology
Berry's Creek Study Area Remedial Investigation

Figure
6

BCSA RESPONSE TO EPA COMMENTS DATED FEBRUARY 22, 2016 AND MARCH 28, 2016 REGARDING THE MEMORANDUM ON HUMAN EXPOSURE SCENARIOS AND ASSUMPTIONS AND THE PATHWAYS ANALYSIS REPORT
AUGUST 30, 2016

The following are the Berry's Creek Study Area (BCSA or Site) Cooperating Parties Group (the Group) responses to U.S. Environmental Protection Agency (EPA) comments on the *Memorandum on Human Exposure Scenarios and Assumptions* and the *Pathways Analysis Report* (February 26, 2015). This document contains EPA's original comments on the subject documents (dated July 2, 2015), the Group's responses to EPA's comments (dated August 27, 2015), EPA's position on those responses (received via e-mail on February 22, 2016, and March 28, 2016), and the Group's subsequent responses to those positions.

The Group is proposing that we will not revise and reissue the subject reports, but instead will incorporate the agreed upon approaches and assumptions into the subsequent submittal of the baseline human health risk assessment (BHHRA) for the BCSA.

The Group's responses to unresolved comments are presented below.

MESA

1. ***Page 5: Human Use, 2nd paragraph - It is stated that white perch are typically in the range of 6 to 8 in. or less while New Jersey Fish and Wildlife considers edible fish to be in the 10 to 12 in. range. Ten inches equates to approximately 250 mm. The recent 2014 white perch age to length data indicate that 10-15% of the perch caught in the BCSA are considered to be of edible size.***

   Additionally, there will be a discussion in the Uncertainty section which qualitatively evaluates the consumption of fish in a stew in which size is of no consequence. Please make this clear in the text.

   PREVIOUS GROUP RESPONSE: A more complete characterization of the size (i.e., length) of white perch found in the study area will be included in the BHHRA. The Uncertainty section of the BHHRA will also recognize that fish of smaller sizes may be consumed by individuals in more limited circumstances (e.g., in stews).

   EPA RESPONSE: EPA accepts this response.

2. ***Page 8: Groundwater Use bullet - Please indicate that groundwater in the area is classified as II-B with a description of this designation. When did the groundwater get this designation rather than Class IIA?***

   PREVIOUS GROUP RESPONSE: The area of site characterization in the BCSA is tidal with brackish surface water. Underlying groundwater can occur in a discontinuous thin veneer of Holocene fluvial deposits that are tidally inundated daily with brackish water. However, the dominant underlying unit is a massive glacial lake varved clay that is not a source of groundwater. The glacial clay deposit is in turn underlain by glacial tell in some areas and by the Passaic bedrock formation, consisting of a reddish-brown shale, siltstone and mudstone with some conglomerate and sandstone beds.

   Based on detailed review of the stratigraphy, permeability and regional geology, the ground water beneath the tidal portion of the BCSA is best described as a combination of:

   (1) Glacial Till and Passaic Formation - Class II-A – Consists of all ground water of the state that is potable or potable subsequent to conventional water treatment, except for ground water designated in Classes I, II, or III. As ground water flow from this unit is towards the tidal discharge area rather than from the tidal area, any contaminants associated with the surface water in the BCSA will not pose a risk to the Class II-A ground water, consistent with the conceptual site model (CSM) presented in the Phase 2 Site Characterization Report. In addition, potable water in the BCSA and surrounding area is provided from a surface water source in the Passaic River Watershed. In relation to the comment, none of the area surrounding the BCSA has been reclassified as Class II-B to the knowledge of the BCSA Group.

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water in the fluvial/marsh deposits. Class III-B applications have been approved for more localized areas within the BCSA, including the UOP Superfund Site and Matheson Tri Gas property.

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References:

Carswell, L.D. 1976. Appraisal of water resources in the Hackensack River Basin, New Jersey. Water-Resources Investigations 76-74. U.S. Geological Survey.

NJGS. 1959. Bedrock map of the Hackensack Meadows. Geologic Report Series No. 1. NJGS-NJDEP.

EPA RESPONSE: Please make clear that groundwater in the vicinity of the Site is classified as II-A (potable) but indicate that it is not currently used for drinking water purposes and is not expected to be used based on the above reasons. Formal re-designation of the aquifer from the NJDEP would bolster this argument. If not, it might be worth evaluating this pathway as a future use scenario to be thorough. Based on the following statement, it is not anticipated to pose an unacceptable risk. "As ground water flow from this unit is towards the tidal discharge area rather than from the tidal area, any contaminants associated with the surface water in the BCSA will not pose a risk to the Class II-A ground water, consistent with the CSM presented in the Phase 2 Site Characterization Report."

GROUP RESPONSE: Groundwater issues are discussed in the remedial investigation (RI) report. Drinking water exposures are not evaluated in the BHHRA as this is not considered a viable pathway even in the future. A full discussion of groundwater and local and regional hydrology is included in the RI Report (Appendix D, Section 2.4). The BHHRA references the RI Report for these discussions.

3. ***Page 10: Last paragraph - Based on the camera study, it was concluded that there is little evidence to suggest that the same person returns to the site to fish or crab. Due to issues such as camera resolution, EPA does not believe that this statement can be made with confidence. Please omit.***

PREVIOUS GROUP RESPONSE: The comment is noted. Future text discussions will indicate that the results of the camera survey cannot be used to determine definitively if individuals return to the Site more than once. No changes are required for the BHHRA exposure factors as the referenced statement was not considered in their development.

EPA RESPONSE: EPA accepts this response.

4. ***Page 11: 1st paragraph - EPA does not consider fishing advisories or other institutional controls in a Baseline Human Health Risk Assessment. There is no guarantee they will be in place indefinitely. Exposure assumptions should be made without consideration of such site use controls.***

   PREVIOUS GROUP RESPONSE: The exposure assumptions were selected without consideration of institutional controls. No changes to the exposure assumptions will be made in response to this comment.

   EPA RESPONSE: EPA accepts this response. Please make this clear in the text.

   GROUP RESPONSE: The text of the BHHRA makes it clear that exposure assumptions were selected without consideration of institutional controls.

5. ***Page 15: 2nd full paragraph, surface water: the diver scenario we saw last year was not included.***

   PREVIOUS GROUP RESPONSE: The BHHRA will recognize this diver as a receptor with associated exposure to surface water through dermal contact. A summary of EPA's analysis and findings of the diver scenario (completed in November 2014) will be provided. EPA's evaluation will be included as an attachment in the BHHRA. See also response to comment #25.

   EPA RESPONSE: EPA accepts this response.

6. ***Page 17: Exposure Duration, 1st paragraph, last sentence: The RME exposure duration for an adult is 8 years regardless of whether a young or older child scenario are evaluated as per reference USEPA 2014b. The ED for adults may be decreased from 14 to 8 years for all exposed populations.***

   PREVIOUS GROUP RESPONSE: The ED for the adult kayaker will be assumed to be 8 years, as requested by EPA.

   EPA RESPONSE: The full excerpt for which this comment referred was, "Following recent EPA guidance (USEPA 2014b), an RME exposure duration of 26 years will be used (updated from the previously assumed 30 years in the draft MESA). For the RME angler/crabber, the exposure durations for the young child (0 to <6 years of age), older child (6 to <18 years of age), and adult are assumed to be 6, 12, and

8 years, respectively. For the RME kayaker/canoer, for whom no exposure for a young child is assumed, the exposure durations for the older child and adult are assumed to be 12 and 14 years, respectively." To remain consistent with the angler/crabber, it was suggested that the adult RME ED be 8 years. EPA accepts this response.

7. ***Page 19: Body Weight - Why use males for the older child angler/crabber but males and females for the older child kayaker/canoer? Please use males only for all scenarios to remain consistent and conservative (if ever so slightly) unless it doesn't make sense to do so.***

   PREVIOUS GROUP RESPONSE: It is noted that the use of a larger male only body weight is less conservative when estimating a receptor's average daily dose for the ingestion pathway. For the BHHRA, it will be assumed that all receptor populations are composed of both males and females. Observations of activities at the Site confirm that recreators are comprised of males and females.

   EPA RESPONSE: EPA accepts this response.

8. ***Page 19: Sediment Ingestion Rate - EPA has never agreed to adjust the fraction ingested and does not approve of this language being included in any risk document. It is Regional policy to not adjust this exposure factor. Please omit.***

   PREVIOUS GROUP RESPONSE: The rationale referenced above will not be included in the BHHRA report. RME and CTE sediment ingestion rates of 100 mg/day and 20 mg/day respectively will be assumed for recreators. A fraction ingested value of 1 will be used for both RME and CTE estimates.

   EPA RESPONSE: EPA accepts this response.

9. ***Page 23: 1st paragraph - While it is recognized that efforts to collect larger size white perch have been unsuccessful in the past, the effort in 2014 did collect fish of an edible size. Is this accounted for within this document? Inclusion of that information would be appropriate in this location.***

   PREVIOUS GROUP RESPONSE: A complete characterization and consideration of the size of white perch collected during the various sampling efforts will be included in the BHHRA.

   EPA RESPONSE: EPA accepts this response.

10. ***Page 24: Top of page - "24 oz." is likely a typo. Is it supposed to be "14 oz.?"***

    PREVIOUS GROUP RESPONSE: 24 oz. will be corrected to 14 oz. in the description of the fish ingestion rates included in the BHHRA.

    EPA RESPONSE: EPA accepts this response.

11. ***Page 25: Crab hepatopancreas - The mean percentage of hepatopancreas to total muscle tissue was selected based on an NJDEP study in Newark Bay. EPA requests that an upper bound estimate of the average be used instead.***

    PREVIOUS GROUP RESPONSE: The NJDEP (2002) reference cited in the MESA reports only a mean percentage, and site-specific data to support the derivation of an upper bound estimate of the average hepatopancreas to total muscle tissue is not available. Use of the proposed value is consistent with USEPA's (1989) RAGS A which supports the use of some mean estimates in deriving RME exposures. The implications of using an average value for this parameter will be discussed in the Uncertainty section of the BHHRA. The BHHRA will continue to use the mean percentage of hepatopancreas to total muscle tissue of 19 percent.

    EPA RESPONSE: EPA accepts this response.

12. ***Page 25: Cooking loss - EPA Region 2 does not support adjustment of contaminant concentration based on cooking loss. We assume that 100% of the contaminants present in tissue are available for consumption.***

    PREVIOUS GROUP RESPONSE: The RME risk estimates will assume that 100 percent of the contaminants present in tissue are available for consumption. In line with other BHHRA's completed under Region 2 EPA, including those completed for the Hudson River and Gowanus Canal, the CTE risk estimates will assume an alternative cooking loss assumption as supported by available scientific evidence.

    <u>References</u>:

    TAMS Consultants and Gradient Corp. 2000. Phase 2 report. Volume 2F. Revised human health risk assessment. Hudson River PCBs Reassessment RI/FS.

    HDR. 2011. Gowanus Canal remedial investigation report. Appendix L. Human health risk assessment.

    EPA RESPONSE: As long as no cooking loss is assumed for the RME scenario, EPA accepts this response.

GROUP RESPONSE: No cooking loss is assumed for the RME scenario.

13. ***Table 1: How were values provided in the column entitled, "Estimated Potential for Direct Contact Time with BCSA Sediment or Water" determined? Please provide some explanation.***

PREVIOUS GROUP RESPONSE: The activities in Table 1 represent actual construction projects that have occurred in the BCSA between 2007 and 2014. During these general activities, the potential for direct sediment contact by the workers occurs only during some aspects of the project. Observations during these activities and knowledge about the overall scope of the project were used as the basis for conservative estimates of the time when a worker would directly contact sediment. As noted in footnote "b," actual contact with the sediment would be reduced by using boots, gloves, and other standard personal protective equipment.

EPA RESPONSE: These values appear to be averages and not upper bound estimates. For the construction/utility worker this information may be useful but selected exposure values must represent a RME scenario.

GROUP RESPONSE: An RME exposure frequency of 40 days/year is used for the construction worker scenario. This value represents the upper end exposure duration from all of the construction projects characterized in Table 1. Moreover, other upper end values including a sediment ingestion rate of 330 mg/kg and a skin adherence factor of 0.3 mg/cm^2-event are used for estimating exposure to construction workers. The combination of these factors results in an RME scenario in line with EPA's definition of an RME – defined as the highest exposure that is reasonably expected to occur at a site (USEPA 1989). USEPA (1989) states that under the RME approach some variables may not be at their maximum values but when in combination with other variables will result in estimates of the RME.

14. ***RAGS Part D, Table 1: For the swimmer rationale it states, "Future exposures will be evaluated qualitatively based on the current use Kayaker/Canoer scenario". The future swimmer should have a greater skin surface area in contact with surface water, exposure time, etc. This is not a sufficient rationale.***

PREVIOUS GROUP RESPONSE: The BHHRA plans to evaluate this scenario in a qualitative manner using the risks estimated for the current and future kayaker/canoers. These kayakers/canoers are assumed to be exposed to surface water for 18 days/year (current) or 39 days/year (future) for 15 minutes per event. It is assumed that kayakers/canoers fall overboard with subsequent dermal exposure over the body's entire surface area, similar to a swimmer. Kayakers/canoers are also assumed to ingest surface water during the time overboard based on a rate suggested by USEPA (1989) for swimming scenarios. The exposure parameters for the future swimmer are envisioned to be consistent with those of the kayaker/canoer and therefore the use of the kayaker/canoer as the basis for the qualitative evaluation of the future swimmer is appropriate.

EPA RESPONSE: EPA accepts this response.

15. ***RAGS Part D, Table 1: The hiker in marsh rationale states, "Future exposures will be evaluated qualitatively based on the current use evaluation." However, there is no marsh hiker evaluated currently.***

PREVIOUS GROUP RESPONSE: As described in the MESA, future hikers in the marsh would use boardwalks or paths constructed as part of future recreational improvements to the BCSA. In these settings the primary exposure would be through inhalation of volatile chemicals and negligible contact with the surface sediments on the marsh surface, as such contact would likely require leaving the constructed path. As proposed, the future marsh hiker will be evaluated in a qualitative manner based on the risks estimated for other recreational receptors that have similar inhalation exposures along with greater contact with marsh sediments (i.e., angler/crabbers and kayaker/canoers).

EPA RESPONSE: EPA appreciates the clarification. Please amend the rationale to reflect this.

GROUP RESPONSE: This rationale is included in the BHHRA.

16. ***Appendix C, page 2: Do the selected studies include those conducted for the SCP site? If not, please explain why not. The SCP documents seem to suggest that the varved clay layer is not as thick under that site, and that contamination from the SCP site has been found within the lodgement till. Please incorporate these findings into this discussion as appropriate. In addition, some contaminants have entered into the bedrock zone and their migration is influenced by pumping supply wells. Please clarify the statements that Berry's Creek groundwater migration is limited, when the SCP information is included in the analysis.***

PREVIOUS GROUP RESPONSE: Information from the investigations at the SCP site has now been included in the evaluation, specifically Golder (2009). At SCP, the glaciolacustrine varved unit is 10–23 ft thick in the vicinity of Peach Island Creek and is overlain by approximately 8 ft of organic silt/ bedded clay so that the combined thickness of low permeability materials above the glacial till is 18–31 ft. Contamination is present in the glacial till as noted in the comment; however, local penetrations of the low permeability materials in the form of historic wells were present[1] and provided a contaminant migration pathway. Groundwater movement through the low permeability materials that underlie the waterways is very limited at SCP and throughout the region.

[1] Identified wells were sealed as part of remedial activities.

EPA RESPONSE: EPA agrees with the incorporation of this information in the risk assessment.

17. ***Appendix C, page 2: Hydrogeological information (including test borings or wells) collected during the Berry's Creek study in the area of the known landfills should be included in this analysis.***

    PREVIOUS GROUP RESPONSE: No wells or test borings were completed in the areas of known landfills as part of the RI. Several borings were attempted but hit refusal just below the surface due to large debris.

    EPA RESPONSE: Information from other studies in the nearby landfills should be included to fully capture the flow of groundwater through the region.

    GROUP RESPONSE: A full discussion of groundwater and local and regional hydrology is included in the RI Report (Appendix D, Section 2.4). The BHHRA references the RI Report for these discussions.

18. ***Appendix C, page 4, 1st full paragraph: The discussion of the location of the Class III-B Ground Water should include mention of the Universal Oil Products site.***

    PREVIOUS GROUP RESPONSE: See Response to Comment #2.

    EPA RESPONSE: See EPA response to comment #2.

    GROUP RESPONSE: A full discussion of groundwater and local and regional hydrology is included in the RI Report (Appendix D, Section 2.4). The BHHRA references the RI Report for these discussions.

19. ***Appendix C, page 4, Summary: Add the glacial/sandier lodgement till unit to this paragraph. It is a significant unit and is the most affected unit at the SCP site.***

    PREVIOUS GROUP RESPONSE: The glacial till present at the SCP site (Rahway Till) has been divided into an upper soft till and a lower, over-consolidated Lodgement Till based on differing physical properties. This distinction may be present but has not been recorded in other studies within the BCSA.

EPA RESPONSE: Please explain how the presence of this unit has the ability to impact contaminant fate and transport.

GROUP RESPONSE: A full discussion of groundwater and local and regional hydrology is included in the RI Report (Appendix D, Section 2.4). The BHHRA references the RI Report for these discussions.

20. ***Appendix C, page 5, last paragraph, 3rd sentence: Something seems to be missing from this sentence.***

PREVIOUS GROUP RESPONSE: "Ground water" was missing from the sentence. The sentence should read, "Within the BCSA, shallow ground water is recharged by rainfall-infiltration processes and discharges to area tidal creeks and marshes.

EPA RESPONSE: EPA accepts this response.

21. ***Appendix C, general: The data from the SCP site suggest that the clay unit is not completely impermeable to contaminant transport because site contamination has reached the lodgement till and the bedrock aquifer. Also note that groundwater in the bedrock aquifer is influenced by pumping industrial wells near SCP. This could alter whether EPA would require that groundwater be evaluated for a potable scenario in the future since it is classified as IIB.***

PREVIOUS GROUP RESPONSE: The glaciolacustrine unit at the SCP site has similar properties to that present in other parts of the BCSA. As noted in response to comment #16, the vertical migration of contamination was most likely associated with localized anthropogenic pathways. As noted in the comment, use of industrial wells can perturbate horizontal hydraulic gradients in the bedrock aquifer; however, the bedrock unit is not hydraulically connected to Berry's Creek. Groundwater movement through the low permeability materials that underlie the waterways is very limited at SCP and throughout the region.

Reference: Golder Associates Inc. 2009. Off-property groundwater investigation report, Operable Unit No. 3, 216 Paterson Plank Road Site, Carlstadt, NJ. July.

EPA RESPONSE: Please provide supporting documentation in an appendix to the risk assessment that illustrates shallow contamination is no longer impacting the deeper bedrock aquifer.

GROUP RESPONSE: A full discussion of groundwater and local and regional hydrology is included in the RI Report (Appendix D, Section 2.4). The BHHRA references the RI Report for these discussions.

PAR

22. ***Please describe how the PCB congener/dioxin TEQ be incorporated into the human health evaluation? There is no mention of it in the PAR.***

    PREVIOUS GROUP RESPONSE: Noncancer hazards and cancer risks from exposure to dioxin like PCB congeners will be evaluated using dioxin TEQs and presented within the uncertainty evaluation of the BHHRA. Noncancer risks will be evaluated using EPA's RfD for 2,3,7,8-TCDD of 7×10^{-10} mg/kg-day. Cancer risks will be evaluated using the cancer slope factor (CSF) developed by California's Office of Environmental Health Hazard Assessment (OEHHA) of 130,000 per mg/kg-day. The CSF from OEHHA is also adopted by EPA in their derivation of regional screening levels (RSLs) for 2,3,7,8-TCDD.

    EPA RESPONSE: EPA asks that cancer risks be evaluated using the CSF of 150,000 per mg/kg-day based on HEAST. While the value is unlikely to have much of an impact on the risk calculations as compared to the OEHHA value, the justification for the CSF must be defensible. The RSLs are not a guidance document while the 1996 PCB Reassessment was peer-reviewed. The HEAST value is provided in example 3 on pages 61-63 in the link below.

    The 1996 Reassessment is titled: *PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures* and is available at: www3.epa.gov/epawaste/hazard/tsd/pcbs/pubs/pcb.pdf.

    Deana Crumbling at EPA Headquarters in the agency's dioxin TEQ expert. I have asked here to run our data through the online TEF calculator. I also ask that the PRP group do the same so that we might compare results. She will need some additional information to do so:

    - Raw spreadsheet file from the lab which was received as the data deliverable.
    - Lab narrative report which discusses QA/QC issues.

    Further information to aid in the evaluation of dioxin and PCB dioxin-like TEQs:

    The dioxin TEFs adopted by EPA are in a 2010 document titled: *Recommended Toxicity Equivalence Factors (TEFs) for Human Health Risk Assessments of 2,3,7,8 Tetrachlorodibenzo-p-dioxin and Dioxin-Like Compounds* and is available at: www.epa.gov/sites/production/files/2013-09/documents/tefs-for-dioxin-epa-00-r-10-005-final.pdf. The TEFs are listed on pages 13 and 14.

    The TEF Calculator is available on the Superfund webpage at: www.epa.gov/superfund/risk-assessment-dioxin-superfund-sites. The calculator is at the bottom of the page.

The TEF for ecological assessment is available at:
www.epa.gov/sites/production/files/2013-09/documents/tefs-draft-052808-0804.pdf.

Finally, Deana has agreed to be available to answer any questions the PRP group or contractors might have with respect to the dioxin TEQ calculations. She can be reached directly at: (703) 603-0643.

GROUP RESPONSE: The CSF of 150,000 is used in the BHHRA for evaluating TEQ.

23. ***Page 2, 3rd bullet: Bidirectional may be an oversimplification, since contaminants can also be transported laterally (e.g., the marshes).***

PREVIOUS GROUP RESPONSE: The term "bidirectional" will not be used to describe the potential movement of COPCs across the Site in the BHHRA. The potential for lateral transport will also be recognized.

EPA RESPONSE: EPA accepts this response.

24. ***Page 4, Future Swimmer, waterways: Please delete the word "primary" in this sentence.***

PREVIOUS GROUP RESPONSE: The term primary will not be used in the above referenced context in the BHHRA (e.g., "In particular, on the Hackensack River, there are at least 15 combined sewer outfalls and the **primary** treatment plant in Little Ferry releases untreated sewage during storm events").

EPA RESPONSE: EPA accepts this response.

25. ***Page 8, Surface Water: As per the comment on the MESA, we should discuss if the diver scenario (with heated surface water pumped inside the wetsuit) should be included in the risk assessment.***

PREVIOUS GROUP RESPONSE: The BHHRA will recognize the diver scenario. As noted in the response to Comment #5, a summary of EPA's analysis and findings of the diver scenario (completed in November 2014) will be provided. EPA's evaluation will be included as an attachment in the BHHRA.

EPA RESPONSE: EPA accepts this response.

26. ***Page 8, last paragraph: Please revise to read, "The lowered risk targets were requested by EPA to add an extra amount of conservatism in the COPC selection given that less-conservative, site-specific RBSLs were being used rather than default screening levels."***

PREVIOUS GROUP RESPONSE: The BHHRA text will include such a statement describing EPA's request to use the specific target risks applied in the screening.

EPA RESPONSE: EPA accepts this response.

27. ***Page 9, 2nd paragraph: How will lead be evaluated qualitatively in the BHHRA?***

    PREVIOUS GROUP RESPONSE: A COPC screening will be completed for lead in sediment in the BHHRA. The screening will compare mean lead concentrations to a back-calculated risk based level for site receptors using the Adult Lead Methodology (ALM). The use of the mean (and not maximum) lead concentration for this proposed screening is in line with EPA's guidance on the use of average concentrations when evaluating risks from lead. If lead becomes a COPC we will evaluate it for the recreator and construction worker sediment direct contact scenarios using the ALM. Exposure parameters for the ALM will be selected to be consistent with those outlined for other COPCs (e.g., RAGS D Table 4 in the MESA) and EPA's guidance on lead risk assessment.

    EPA RESPONSE: EPA concurs with the use of the ALM and mean lead concentrations to evaluate lead risk at the Site.

28. ***Page 10, l " paragraph: In soft sediments such as found in Berry's Creek, EPA prefers that a depth of contact for waders would be 15 cm (6 in.). This depth has been used at other sediment sites in the region as well.***

    PREVIOUS GROUP RESPONSE: For evaluating recreational scenarios, the BHHRA will use sediment data from 0 to 15 cm in soft waterway sediments when available. The majority of the surface sediment data collected from BCSA waterways is collected from the biologically active zone (BAZ) – either 0 to 6 cm in UBC or 0 to 10 cm in the other BCSA reaches – and does not extend to 15 cm. In a subset of locations, however, some cores are available that extent from the BAZ to 15 cm and data from these locations will be used in the risk assessment. Shallow BAZ samples (operationally defined in the RI Report as 0 to 2.5 cm) will not be used to estimate recreational exposures, however, because they represent a small portion of the sediment column to which recreators could potentially be exposed.

    EPA RESPONSE: EPA accepts this response.

29. ***Page 10, Chemical-Specific Sampling Results Considered in PAR, Surface Water: Table 2.5 (Dissolved concentrations) should not be used to evaluate human exposures.***

PREVIOUS GROUP RESPONSE: The COPC screening will use total concentrations in surface water. The calculation of baseline risks in the BHHRA will also use the total concentrations in surface water. Due to the conservative nature of this approach for dermal exposures the BHHRA may include a second tier evaluation using dissolved concentrations for the dermal exposure pathway.

EPA RESPONSE: EPA does not concur with the use of dissolved samples in a surface water scenario. It is not feasible that the water would be filtered prior to a recreator contacting it.

GROUP RESPONSE: Total concentrations in surface water are used for evaluating both incidental ingestion and dermal contact with surface water.

30. ***Page 10, Chemical-Specific Sampling Results Considered in PAR, Surface, Fish/Crab: Please clarify why it was determined that the exposure evaluation would be conducted by reach for fish, while it is being done site wide for crabs.***

PREVIOUS GROUP RESPONSE: The BHHRA will calculate risks via crab consumption on a reach-specific basis. The RAGS D Table 2 series referenced in the comment present site-wide data summaries for all media. The RAGS D Table 3 series present EPCs by media and reach.

EPA RESPONSE: EPA accepts this response.

31. ***Page 11, Exposure Point Concentration Summary: A concentration-toxicity screen was used to focus the PAR on contaminants that contribute most significantly to risk. In EPA RAGS Part A, there are many other factors to consider when proposing this approach, none of which were discussed in the PAR. From RAGS A: "The concentration-toxicity screen in particular may be needed only in rare instances." "Quantitative evaluation of all chemicals of potential concern is the most thorough approach in a risk assessment." It is EPA Regional policy to carry contaminants through the risk assessment and identify contaminants as not site-related (e.g., resulting from background contamination) in the risk characterization section. Also, the suggested ratio to use as per RAGS is 0.01 or lower, orders of magnitude below the suggested value of l0 in the Draft PAR. Since EPA has agreed to allow site-specific screening values to be developed for use at the site which are less conservative than default screening levels, an additional attempt to further screen out contaminants is not appropriate. As a result, this approach is not supported by EPA.***

PREVIOUS GROUP RESPONSE: The BHHRA will complete a screening on all detected chemicals. Any chemical with a maximum concentration that exceeds the selected site-specific RBSL will be carried forward and evaluated in the BHHRA.

EPA RESPONSE: EPA accepts this response.

Final
Appendix B
Chronology of Natural and Anthropogenic Events

Berry's Creek Study Area
Remedial Investigation

Submitted to

U.S. Environmental Protection Agency

Submitted by

Berry's Creek Study Area Cooperating PRP Group

April 2018

TABLE OF CONTENTS

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LIST OF ACRONYMS

BCC	Berry's Creek Canal
BCMC	Bergen County Mosquito Commission
BCSA	Berry's Creek Study Area
cfs	cubic feet per second
COPC	chemical of potential concern
LBC	Lower Berry's Creek
MBC	Middle Berry's Creek
mgd	million gallons per day
NAVD88	North American Vertical Datum of 1988
NJDEP	New Jersey Department of Environmental Protection
NJMC	New Jersey Meadowlands Commission
NJPDES	New Jersey Pollutant Discharge Elimination System
NJSEA	New Jersey Meadowlands Sports and Exposition Authority
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
STP	sewer treatment plant
ya	years ago

Note: Tables and figures may have additional acronyms and abbreviations.

SECTION 1

INTRODUCTION

The Berry's Creek Study Area (BCSA) is a side embayment watershed of the Hackensack River with a fringing marsh system. Current conditions are the result of a combination of past and current events and activities. An understanding of these events and activities is necessary to provide context for the interpretation of data on chemicals of potential concern (COPCs), in relation to the current and projected physical, chemical and biological templates in the BCSA. In addition, this historical context is valuable in formulating remedial alternatives that are compatible with the urban system and realistic given the regional conditions that influence conditions in the study area.

To prepare this chronology, more than 100 documents were reviewed to identify events and activities that likely had a sustained influence on the physical, chemical, and biological templates and COPC distribution/fate and transport. Only particularly relevant references are reflected in this summary and the citations herein. Events and activities that were identified are grouped into seven categories for discussion purposes:

1. Geologic history (last glaciation to present)

2. Sea level changes

3. Major storms (hurricanes and precipitation)

4. Hydrology modifications (including reservoirs, dredging, diking, ditching, canal construction, mosquito management, and tide gates)

5. Plant community changes

6. Land development progression (including progression of wetland filling and infrastructure development in tidal area, and landfilling)

7. Sewage management and treatment practices (including sewage and industrial discharges).

Each of these discussion categories has a relatively distinct history, which is documented within this appendix. The nature and the probable relevance of each factor are presented in chronological lists, with the relevant start year or date range identified in bold. A summary of key points and relevance to the remedial investigation/feasibility study (RI/FS) is included in the text of the Remedial Investigation (RI) Report.

SECTION 2

GEOLOGIC HISTORY

The most recent extensive glaciation that occurred over the Hackensack Meadowlands modified the hydrology and landscape. Landscape modifications that accompanied the glacial retreat established much of the physical template for the BCSA. The chronology of these modifications is summarized herein.

20,000 years ago (ya): Woodfordian glacier covered the New Jersey Meadowlands, Manhattan Island, and Upper New York Bay (McCully 2007). The terminal moraine was located in the vicinity of southern Staten Island and Perth Amboy, New Jersey (Stone et al 2002; Wright 1988; Figure 1). During the last glacial maximum, glacial ice was approximately 1.6 km (1 mile) thick (Wright 1988) and sea level was approximately 120 m (394 ft) lower than present (Wright et al. 2009). The coastal plain extended approximately 80 to 160 km (50 to 100 miles) farther east than the present coastline. The Connecticut, Housatonic, Passaic, and Hackensack rivers drained via the Hudson, which cut a deep gorge through the coastal plain offshore of the current coastline (McCully 2007).

19,000–17,000 ya: Glacial ice began to retreat at a rate of approximately 18 to 30 m (60 to 100 ft) per year (Wright 1988). Proglacial lakes Hackensack and Hudson extended from the terminal moraine to the ice front at Little Ferry (Averill et al. 1980; Figure 1). Lake Hackensack existed for at least 2,500 to 3,000 years, based on the number of varves in clay deposits (Heusser 1949). The start of glacial ice retreat marks the beginning of a transgressive sequence characterized by sea level rise (see Section 3) and depositional conditions.

15,900 ya: Catastrophic drainage of Lake Hackensack occurred through Jersey City lowlands to the south and through Sparkill Gap (New York) to the north. Erosion, desiccation, and reforestation of lake bottom sediments occurred (Averill et al. 1980).

15,200 ya: A short-lived re-advance of Hudson Valley ice into Hackensack River Valley took place (Averill et al. 1980).

15,000 ya: Glacial retreat created Lake Tappan (New York) as well as other proglacial lakes (Averill et al. 1980).

13,000 ya: Lake Tappan catastrophically breached through Old Tappan moraine and drained southward via Sparkill Gap. Post-glacial Lake Norwood was created in the mid-Hackensack valley as a result of the Lake Tappan drainage (Averill et al. 1980).

11,000 ya: Lake Norwood drained and established the present-day Hackensack River drainage patterns (Averill et al. 1980).

11,000 ya to 20th Century: This is an interglacial period characterized by relative stability in terms of hydrology, sedimentology, and ecology. Sediment deposition in the BCSA waterways occurred slowly following glacial retreat, with total Holocene-age sediment thickness ranging from approximately 1.5 to 3 m (5 to 10 ft) (Earthworks 2008).

20th Century: Sediment deposition and marsh accretion continued throughout the Hackensack Meadowlands, including the BCSA. Well logs from within the study area identify depth to sandstone or shale bedrock ranging from about 23 to 79 m (75 to 260 ft) below the current tidal area. Logs confirm presence of clay, sand, and gravel overlying the bedrock (NJGS 1959), which may be outwash from glacial lake drainage events. Varved clay sediments are present in deposits as much as 91 m (300 ft) thick in two troughs (Carswell 1976). When the wells were installed pre-1959, surficial marsh deposits were reported to range in thickness from approximately 1.2 to 3 m (4 to 10 ft) (NJGS 1959).

2008–2015: Results from the RI support a conclusion that net sediment deposition has occurred in the waterways and marshes of the BCSA during the last 100 years (e.g., high-resolution coring[1]). In addition, surface elevation tables and feldspar beds were installed in five marshes throughout the Meadowlands, including two BCSA marshes (NJSEA 2015a,b). The average accretion rate of all Meadowlands marsh locations over approximately 6 years was 7.4 mm/yr (0.29 in./yr). In the BCSA, average marsh accretion rates are reported to be 7.7 mm/yr (0.3 in./yr), higher than the average of 6.9 mm/yr (0.27 in./yr) in other Meadowlands marshes (NJSEA 2015b).

Analysis of RI data indicates the rate of sediment accumulation in the waterways since the 1950s has been greater than previous periods, probably the result of hydrologic modifications (Section 5), rapid reduction in tidal marsh area due to development activities in the 1960s and 1970s (Section 7), and possibly related to increasing rate of sea level rise, especially in the Mid-Atlantic Region (NOAA 2014).

[1] Refer to Attachment F1 of Appendix F.

SECTION 3

SEA LEVEL CHANGE

Sea level is a state factor (sets template for large number of the physical, chemical, and biological conditions) of estuaries, much the way climate is for upland landscapes. In the Hackensack River estuary, sea level has undergone periods of rapid change as well as periods of relative stability. The chronology of these changes is summarized herein.

20,000 ya: Sea level was approximately 120 m (394 ft) lower than present (Wright et al. 2009). As a result, the coastal plain extended approximately 80 to 160 km (50 to 100 miles) farther east than the present coastline (McCully 2007).

19,000–10,000 ya: Glacial retreat and related sea level rise occurred (McCully 2007; Montalto and Steenhuis 2004).

7,500 ya: Relative sea level rise occurred at a rate of approximately 2 mm/yr (0.08 in./yr) (Stanley et al. 2004).

5,000–2,500 ya: Relative sea level continued to rise at a rate of approximately 1.8 mm/yr (0.07 in./yr) along the New Jersey coast; a total sea level rise of 2 to 5 m (6.6 to 16.4 ft) occurred during this period (Miller et al. 2009).

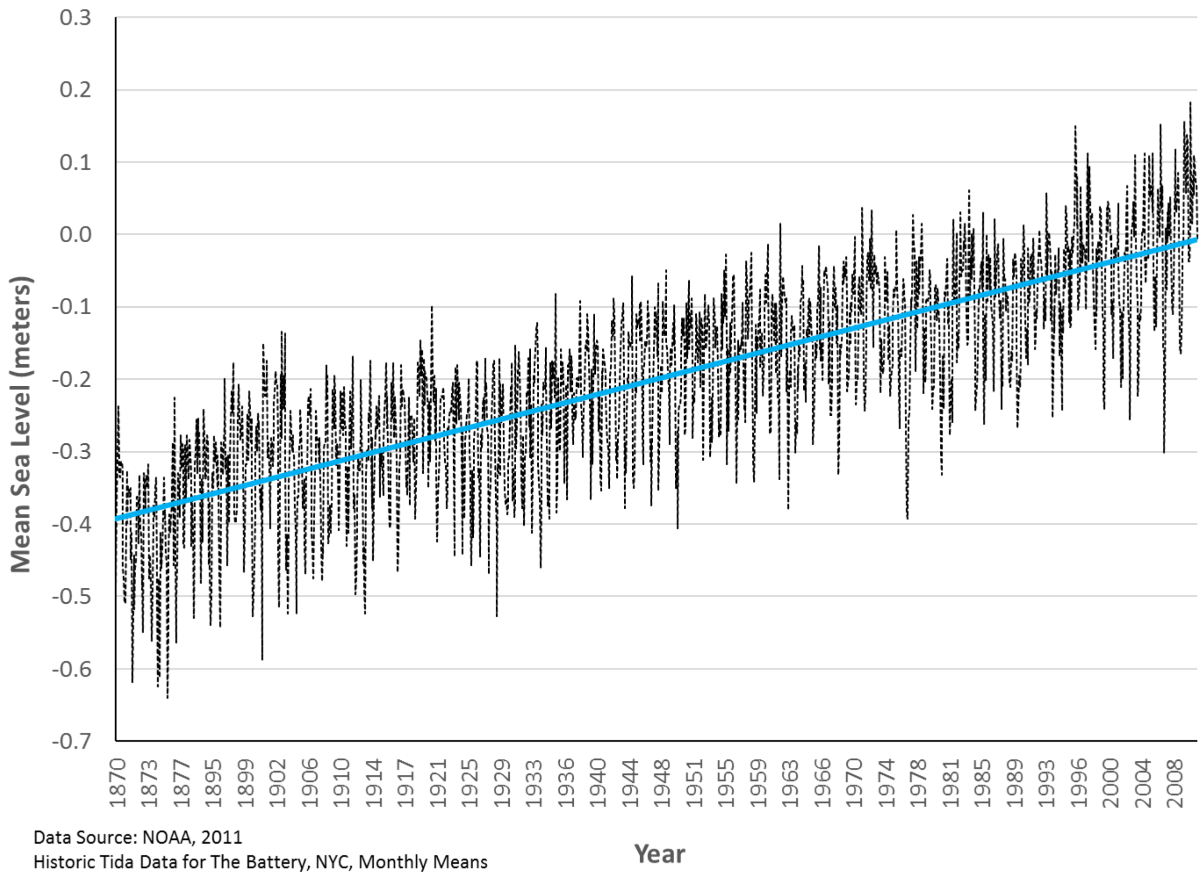
2,500 ya: Sea level was approximately 3.7 to 4.6 m (12 to 15 ft) lower than present (Grossman & Associates 1997). Pollen data from the Hackensack Meadowlands (Kearny, East Rutherford, and Secaucus) support that sea level had risen approximately 3 m (9.8 ft) over the last 2,000 years (Heusser 1963).

1870–1878: Mean sea level at the Battery (New York) was approximately 0.45 m (1.5 ft) lower than present based on tide gauge data (NOAA 2011).

1899–1900: Mean sea level at the Battery (New York) was approximately 0.37 m (1.2 ft) lower than present based on tide gauge data (NOAA 2011).

1900-1999: Based on the difference between the steady 2 mm/yr (0.08 in./yr) observed during the past 7,500 years and the rate of sea level rise in the 20th century, an anthropogenically induced rise in sea level due to global warming was calculated as approximately 1 mm/yr (0.04 in./yr) (Stanley et al. 2004; Miller et al. 2009).

1905–1999: Measured relative sea level rise of 2.77 to 3.3 mm/yr (0.11 to 0.13 in./yr) in the New York region (Zervas 2001, as cited by Titus 2009 Table 1-1; Miller et al. 2009). The long-term pattern for the full Battery record evaluated (1870–2010) is illustrated in the inset graph below.



Graphic 1. Long-Term Sea Level Trend at The Battery, New York, NY (1870-2011)

June–July 2009: Abnormally high tide elevations (>0.2 m; 0.66 ft) were measured throughout the East Coast, including within the BCSA. This observation was attributed to wind-driven tides, as well as short-term changes in oceanic circulation (Florida Current) (NOAA 2009).

Present–2100: Sea level rise is predicted at rates ranging from 4.6 to 7.8 mm/yr (0.18 to 0.31 in./yr) Church and Clark 2014). Based on measurements by the New Jersey Meadowlands Commission (NJMC), marsh accretion in most areas of the Meadowlands is predicted to occur at a sufficiently high rate to keep up with sea level rise (approximately 7.7 mm/yr; 0.3 in./yr; NJSEA 2015b).

SECTION 4

MAJOR STORM EVENTS

Storms have a substantial influence on the structure and geomorphology of estuaries. Major storm events affecting the BCSA over the last century were identified through analysis of precipitation data[2] and lists compiled by various weather agencies (e.g., the National Weather Service, Weather Underground, and National Oceanic and Atmospheric Administration). Table 1 presents a summary of major storms of record, or their remnants, with courses in proximity to the BCSA.

Storms listed in Table 1 all resulted in rainfall and strong wind in northern New Jersey, including named tropical storms or hurricanes that did not necessarily make direct landfall in the state. Precipitation data from Newark International Airport (1893–2015) were evaluated to identify storm events that generated above average rainfall in the BCSA. The results of this analysis are summarized in Table 2.

Table 1. Hurricanes and Tropical Storms Impacting the BCSA, 1893 to 2015

Date	Event	Intensity at Time of Impact[a]	Precipitation Total (in.)[b]
September 16, 1903	Unnamed hurricane (a.k.a. Vagabond Hurricane)		2.7
September 21, 1938	New England Hurricane	Category 3	5.0
September 12–14, 1944	Great Hurricane of September (The Great Atlantic Hurricane)	Category 3	9.8
September 1, 1952	Hurricane Able	Tropical Storm	2.1
August 31, 1954	Hurricane Carol	Category 3	1.0
October 15, 1954	Hurricane Hazel		0.3
August 18–21, 1955	Hurricanes Connie & Diane	Tropical Storms	2.7
September 12, 1960	Hurricane Donna	Category 2	3.5
August 27–28, 1971	Tropical Storm Doria	Tropical Storm	8.0
June 22, 1972	Tropical Storm Agnes	Tropical Storm	1.0
September 27, 1985	Hurricane Gloria	Category 2	3.4
August 30, 1988	Tropical Storm Chris	Tropical Storm	0
September 19–20, 1989	Hurricane Hugo		3.7

[2] Based on data requested from the National Centers for Environmental Information (ncdc.noaa.gov) for Newark, New Jersey. In the data package received, the data from February 1, 1931, to the present were from Newark Airport, but the location of data pre-1931 was not provided.

Table 1. Hurricanes and Tropical Storms Impacting the BCSA, 1893 to 2015

Date	Event	Intensity at Time of Impact[a]	Precipitation Total (in.)[b]
October 8–10, 1990	Hurricane Klaus/Tropical Storm Marco	Tropical Storm	2.1
August 19, 1991	Hurricane Bob		2.7
October 31, 1991	1991 Halloween Nor'Easter (The Perfect Storm)	Nor'Easter	0
September 26, 1992	Tropical Storm Danielle	Tropical Storm	1.3
November 21, 1994	Hurricane Gordon		1.3
August 17, 1995	Hurricane Felix	Category 2	0
October 5, 1995	Hurricane Opal		1.7
July 13, 1996	Hurricane Bertha	Tropical Storm	2.0
September 2, 1996	Hurricane Edouard	Category 1	0
September 8, 1996	Hurricane Fran		1.2
July 25, 1997	Tropical Storm Danny	Tropical Storm	5.0
September 16, 1999	Hurricane Floyd	Tropical Storm	6.2
June 17, 2001	Tropical Storm Allison	Tropical Storm	0.9
September 13, 2003	Tropical Storm Henri	Tropical Storm	0.9
September 14–18, 2004	Tropical Storm Bonnie, Hurricane Charley, Hurricane Ivan	Tropical Storm	2.3
September 28–31, 2004	Hurricane Jeanne, Tropical Storm Gaston	Tropical Storm	Trace
September 6, 2008	Hurricane Hanna	Tropical Storm	3.7
August 22, 2009	Hurricane Bill	Category 1	0.6
August 27–28, 2011	Hurricane Irene	Category 1	8.9
September 6–8, 2011	Tropical Storm Lee	Tropical Storm	5.0
October 29–30, 2012	Superstorm Sandy (Hurricane)	Tropical Storm	0.6

Notes: [a] If known.
[b] Total includes preceding and residual precipitation around the identified storm date.

Only 5 of the 10 largest storm precipitation events from 1893 to 2015 were associated with a named tropical storm or hurricane (Table 2). The third largest single day rain event on record occurred in August of 2011, during the remedial investigation. August 2011 was also the wettest month on record, with a total of 18.8 in. Based on additional analysis of recent precipitation data (1975–2014), the frequency of large storm events is higher in recent years than 40 years ago. The occurrence of storms greater than 3 in. and 4 in. total precipitation increased each decade during the period of analysis. However, average annual precipitation was similar among decades (Graphic 2), and to the long-term average annual precipitation (approximately 46 in. per year). Precipitation in 2011 greatly exceeded the long-term average, with more than 69 in. total. The frequency of larger storms was also more common in 2011 than other years on record, with six storms exceeding 2 in. total precipitation, four storms exceeding 3 in., and two storms exceeding 4 in.

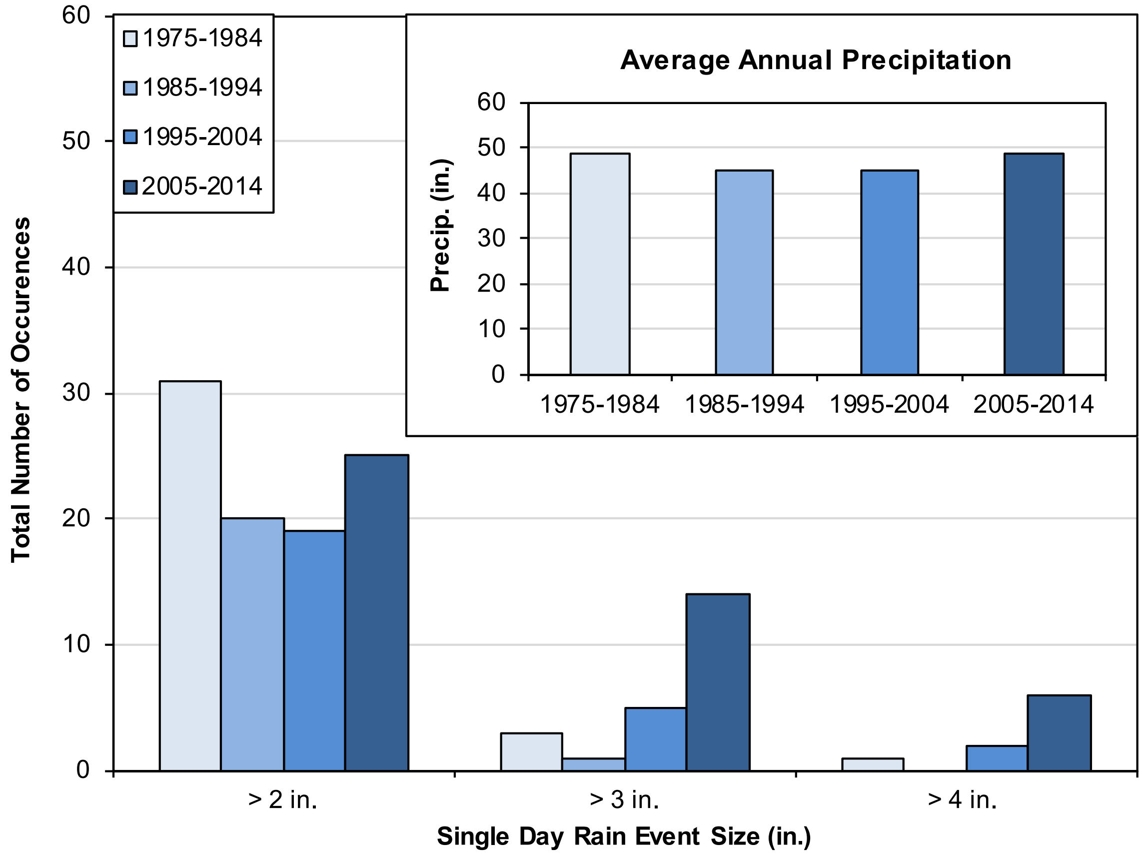
Table 2A. Ten Largest Storm Events Impacting the BCSA, 1893 to 2015

Rank	Year	Date(s)	Precipitation (in.)	Notes
1	1903	October 8–9	11.58	
2	1944	September 12-14	9.79	The Great Atlantic Hurricane
3A[a]	1955	September 7 & 11–13	9.05	Hurricanes Connie and Diane
3B	2011	August 27–28	8.92	Hurricane Irene
4	1977	November 7–8	8.25	
5	1971	August 27–28	7.97	Tropical Storm Doria
6	1897	July 28	7.67	11-day period from July 18–28 produced 12.71 in.
7	2011	August 14	6.40	
8	1999	September 16	6.22	Hurricane Floyd
9	2007	April 15	6.18	
10	1955	August 11–13	5.81	Hurricane Diane

Note: [a]Connie struck September 7; Diane and related weather persisted from September 11–13.

Table 2B. Ten Largest Single Day Precipitation Events, 1893 to 2015

Rank	Year	Date	Precipitation (in.)	Notes
1	1897	July 28	7.67	
2	1977	November 8	6.73	
3	2011	August 14	6.4	
4	1999	September 16	6.22	Hurricane Floyd
5	2007	April 15	6.18	
6	1903	October 9	5.94	
7	1971	August 27	5.93	Tropical Storm Doria
8	1913	October 1	5.75	
9	1903	October 8	5.64	
10	2011	August 28	5.22	Hurricane Irene



Graphic 2. Storm Frequency by Decade (1975–2014)

The frequency of large magnitude storm tide surges is less certain. Some co-occur with large magnitude precipitation events, but others are largely independent of precipitation, driven by strong winds (e.g., Nor'easter) combined with high tide conditions based on the lunar cycle. In 2012, Superstorm (Hurricane) Sandy made landfall along the Mid-Atlantic with a storm surge peak near the BCSA measured as approximately 8.8 ft mean sea level[3] (NJIT 2014). This caused extensive flooding in the BCSA.

[3] The reported peak tide elevation for Hurricane Sandy was measured at the River Barge Park Marina tidal gauge (New Jersey Meadowlands Environmental Research Institute), because water elevation data in the BCSA are not available from the time of the storm.

SECTION 5

HYDROLOGY MODIFICATIONS

The hydrology and associated sediment transport of the entire Hackensack River watershed has been extensively modified by human activity. The chronology of these changes is summarized herein.

5.1 Watershed Modifications

The following is a chronology of watershed modifications within the area.

1600s–1800s: Property lot trenching (demarcation trenches [6 ft × 2 ft] dug along property lines) and some drainage ditch construction occurred (McCully 2007; Marshall 2004).

1849: East and West Riser ditches (east and west side of current day Teterboro Airport) are evident on maps of the BCSA in approximately their current location/configurations (Sidney's Map of Twelve Miles Around New York City, in Grubb 2010 [Appendix F of BCSA Group 2010]).

1870: Clay underlying the marshes was mined for brick making, in localized areas of the BCSA and elsewhere in the Hackensack Meadowlands. The industry peaked in 1895, but continued until the 1950s. The clay pits are now filled in but readily collect water, and some have the appearance of ponds where they have not been obscured by development (Sullivan 1998).

1896: Diking along south bank of Saw Mill Creek created 2,170 acres of sunken marsh (i.e., Kingsland Marsh) between Saw Mill Creek and Berry's Creek (HMDC 1973).

1896: Railways crisscrossed the Meadowlands, including the BCSA. The filling and grading of the track beds disrupted natural tidal cycles altering freshwater and saltwater distribution. Cedar swamps were further reduced by saltwater encroachment (Weis and Butler 2009) due to hydrologic changes.

1896: Berry's Creek was reportedly used for some canal barges to a point in the vicinity of current day Paterson Plank Road (Vermeule 1896, reproduced in HMDC 1973), although there was no evidence of this activity extending into the 1900s or involving navigational dredging.

1898: Deed records for the purchase of land extending from Hackensack River along Berry's Creek to Rutherford noted an extensive network of ditches that had been used to divide properties; also, historical freshwater tributaries are described (Wright 1988).

1905: Concrete tide gates were constructed on the East and West Riser ditches by the Riser Company (HMDC 1973). The East Riser tide gate was originally located somewhat upstream of its present location, while the West Riser tide gate was close to its current location.

1911: Berry's Creek Canal (BCC) was constructed for the purpose of "removing perils and delays now incident to the navigation of Berry's Creek" (Erie Railroad Company 1910). The construction of BCC allowed the Erie Railroad Company to construct a fixed rail bridge over Berry's Creek (Erie Railroad Company 1910). Diversion of Berry's Creek flow from upstream of the rail line into the newly constructed canal effectively resulted in a substantially reduced hydrologic connection between the upper portions of Berry's Creek and the lower portion of Berry's Creek (Lower Berry's Creek [LBC]). In addition, the canal was constructed as a straight channel and the cross section was significantly larger (deeper and wider) than LBC, which altered the flow dynamics into middle and upper Berry's Creek.

1912: Initial dredging of the lower Hackensack River was authorized to create a uniform 12-ft-deep channel at mean low tide, from Newark Bay to Little Ferry (approximately 5.5 miles upstream from the confluence of BCC and the Hackensack River; U.S. War Department 1912). Original thalweg depths between the bay and Snake Hill (approximately 3 miles downstream from BCC) were in the range of approximately 7 to 25 ft, with numerous mud deposits in the lower reach and localized deeper points up to 45 ft (Coast Survey Office 1845). Depths upstream near New Milford were as little as 2 ft at mean low tide prior to dredging (GPO 1918). The dredging, combined with the construction of the BCC, increased the influence of storm surges into all reaches of the BCSA, including transport of more saline water into the waterways and marshes.

1915: Approximately 186,000 linear feet (35+ miles) of ditches were cut in BCSA marshes by the Bergen County Mosquito Commission (HMDC 1973).

1916–1918: Ongoing work by the Riser Land Company to drain swamps around the East Riser Ditch for development in Lodi, Little Ferry, and Moonachie. Ditch maintenance and channelization was ongoing in the West Riser during this time period as well (HMDC 1973).

1917: The U.S. Army Corps of Engineers received approval to deepen the lower Hackensack River channel to 16 ft, from Newark Bay to the rail bridge 1 mile upstream along the Hackensack (approximate location of present day Route 440 bridge between Kearny and Jersey City, about 5.5 miles below LBC) (GPO 1918). This change further connected the BCSA to storm tides and increased salinity by facilitating flow of saline water further upstream.

1922: Berry's Creek tide gate was replaced [this apparently refers to the West Riser tide gate] (HMDC 1973).

1924: Ten miles of canals existed in Teterboro to drain wetlands, and 800 ft of dike was added in the Carlstadt Meadow. The addition of 210 ft of dike east and south of the East Riser brought the dike within 1,200 ft of Peach Island Creek (HMDC 1973).

1930 (approx.): The Hackensack River was deepened and widened between the confluence of LBC and BCC, apparently as a landing area for sea planes. The area is known as Harmon Cove and has subsequently filled in completely (Earthworks 2008), although the river remains substantially wider at this location.

1930–1947: A net increase of 6.4 miles of waterways was created within the BCSA. The gain was primarily associated with drainage ditches constructed during development of Paterson Plank Road and Route 3 (ELM 2008).

1950 (approx.): A pump station was constructed on the West Riser Ditch in Teterboro. The design capacity was 90 cubic feet per second (cfs), which was designed to be adequate to prevent flooding during the 7- to 10-year storms at the time of construction (Manganaro, Martin and Lincoln 1970).

1961–1968: Based on review of historical aerial photographs, the lower portion of the East Riser Ditch was further channelized/straightened between the current tide gate location and Moonachie Avenue during this time period (ELM 2008). This work was undertaken by the Riser Land Company (HMDC 1973). The original course of Ackerman's Creek in Middle Berry's Creek (MBC) was also filled in and developed between 1961 and 1966, with only the upper section abutting the railway adjacent to Route 17 remaining (ELM 2008). Flow from Ackerman's Creek was redirected to a new, straight ditch connecting to Berry's Creek.

1967–1968: Based on aerial photograph review, the Peach Island Creek tide gate was constructed during this time period (ELM 2008).

1971–1974: The Rutherford tide gate was constructed (ELM 2008).

1950–1971: Approximately 2,000 acres of wetlands were filled in the BCSA, which reduced the tidal prism. This was partially offset by sea level rise during that period and the subsequent decades (ELM 2008).

1969–1991: Diversion of sewage effluent from multiple publicly owned treatment works in the BCSA to the Little Ferry sewage treatment facility on the Hackensack River removed approximately 4 million gallons per day (mgd) of freshwater inputs from the BCSA (refer to Section 7).

1972: Construction of the New Jersey Meadowlands Sports and Exposition Authority (NJSEA) sports complex between Walden Swamp and Washington Avenue added more than 300 acres of impervious surfaces, with stormwater directed to retention basins that periodically discharged into Berry's Creek near the Route 3 Bridge from a single point discharge (ELM 2008).

Also, passage of the federal Clean Water Act in 1972 implemented regulations that limit filling of wetlands, which is reflected by a substantial decrease in wetland loss in the BCSA subsequent to that time.

1975–1979: Based on aerial photo review, Harmon Cove development was built along the Hackensack River in Secaucus, across from the mouth of LBC (ELM 2008; historicaerials.com). This project included some dredging in the Hackensack for construction of a marina on the east side of the Hackensack River.

1981: The East Riser tide gate was relocated to its present location (Walsh and Miskewitz 2013).

1896–2002: Net 63 percent reduction in wetland/open water acreage in the BCSA resulted in a reduction in the tidal prism (ELM 2008).

1930–2002: Channel gains and losses[4] in the BCSA were quantified based on review of historical aerial photographs (ELM 2008), as summarized in Table 3.

Table 3. Comparison of Channel Losses and Gains between Years of Analysis in the BCSA

Period of Analysis	Channel Gain (ft)	Channel Loss (ft)	Net Gain/Loss (ft)
1930 to 1947	37,248	3,565	33,683
1947 to 1951	1,253	955	298
1951 to 1961	20,514	24,964	-4,450
1961 to 1968	26,179	76,540	-50,361
1968 to 1971	7,508	39,121	-31,613
1971 to 1989	8,470	53,148	-44,678
1989 to 1994	1,558	0	1,558
1994 to 2002	1,899	340	1,559
2002 to 2009	0	1,100	-1,100
Totals	**104,630**	**199,733**	**-95,103**

2007: The Teterboro stormwater pumping station originally constructed on the West Riser Ditch in the 1950s was substantially upgraded by the Borough and the NY/NJ Port Authority to pump

[4] In almost all cases, gains and losses are the result of anthropogenic activities. Gains consist primarily of new channels constructed for stormwater management, mosquito control, or to redirect flow for development. Losses typically occurred from filling associated with development.

up to 175 cfs during storm events (essentially double the previous capacity), to reduce flooding in the vicinity of the airport (Gazette 2008).

2007: West Riser tide gate was observed to be minimally functional and in need of replacement (NJMC 2007).

2007–2009: A total of 10 tide control structures (e.g., tide gates and stormwater pipes with flap valves) were identified in the BCSA (NJMC 2007). Based on visual inspections performed by NJMC in 2007, only 4 of the 10 tide control structures were reported as fully functional. The Rutherford, East Rutherford, and Palmer Terrace tide gates were all replaced during this time period to alleviate tidal flooding, particularly along the East Rutherford Ditch and in the vicinity of Route 17 (Louis Berger Group 2007). As part of this work, a substantial volume of sediment was removed from the ditches upgradient of the tide gates and disposed of by the NJMC.

2007–2009: New Jersey Transit Railroad Bridge project was constructed along the north and west edges of Ackerman's Marsh and over Berry's Creek (as observed by field personnel and evident on aerial photographs (historicaerials.com). The crossing over Berry's Creek is located south of Paterson Plank Road and north of the confluence of Ackerman's Creek. In-water structures to support the bridge have altered the hydrologic flow in the area upstream and downstream of the bridge.

2009: Repairs were performed on the Peach Island Creek tide gate, due to leakage resulting in localized flooding upstream of the tide gate (NJMC Personal Communication).

2010: A substantial volume of sediment was removed from the Ackerman's Creek area (west of Murray Hill Parkway) as a non-time-critical removal action for the Universal Oil Products site. The removal area was not backfilled and resulted in localized changes in hydrology.

2014: NJMC, with funding from the NY/NJ Port Authority, replaced the West Riser tide gate structure (NJMC 2014). Prior to the tide gate replacement, approximately 4,650 cubic yards of contaminated sediment was removed by Morton International from upstream and downstream of the tide gate, and replaced with clean fill (Parsons 2010).

2014-2015: Peach Island Creek tide gate was not functional for approximately 9 to 12 months (one flap gate missing, one flap gate not opening) and diurnal tidal influence was evident upstream of the tide gate. Repairs were completed in mid-2015 that involved replacement of the missing flap gate limiting tidal influence upstream of the tide gate.

2015–2016: New Jersey Turnpike Exit 16W was widened and lengthened for the southbound access lane and shoulder. This exit crosses over BCC, just upstream of the confluence with the Hackensack River. Structures associated with the exit improvements could affect the hydrology of the system.

5.2 Water Supply

The chronology of water supply within the area is as follows:

Late 1860s: Municipal water systems (Hackensack Water Company) utilized freshwater diversions and started using wells and holding pools along Hackensack for water supply (Marshall 2004).

1902: Oradell Dam was constructed and the Oradell Reservoir was created, with a capacity of 250 million gallons (Wright 1988).

1911–1916: Oradell Reservoir was enlarged by excavation and dredging (Wright 1988).

1917: Hackensack River (freshwater) discharge at New Milford (upstream of current dam location) was approximately 183 cfs (GPO 1918). This represented approximately 0.9 percent of the tidal flow entering the Hackensack River just upstream of the New Jersey Turnpike as estimated by Mattson and Vallario (1976).

1921: A 22-ft-high concrete dam was completed and further excavation expanded the Oradell reservoir capacity to 1.6 billion gallons (Wright 1988). The dam itself, and increased development in the region, resulted in greater withdrawals from the reservoir, and reduced downstream freshwater discharges to the lower Hackensack River estuary (NJMC 2004).

1922–2000: Average Hackensack River (freshwater) discharge at New Milford (near the Oradell Dam) declined at a rate of approximately 1 cfs per year (USGS 2011). Average river discharge is summarized by decade in Table 4. A declining trend in average discharge was also evident at Rivervale (located upstream from Oradell), but was less significant.

Table 4. Average Hackensack River Discharge at New Milford (1922–2010)

Decade	Average (cfs)
1920	130.8
1930	121.0
1940	128.2
1950	114.4
1960	57.7
1970	85.2
1980	60.0
1990	53.9
2000	62.8

Note: USGS (2010), retrieved October 2015

1956: The Lake DeForest Reservoir was constructed in the upper Hackensack River basin in Clarkstown, New York, with a capacity of 5.6 billion gallons (USACE 1978).

1967: The Lake Tappan Reservoir was constructed on the Hackensack River, with a capacity of 3.5 billion gallons (USACE 1979).

1967: Average Hackensack River discharge at the USGS gauging station at Rivervale (approximately 4 miles downstream of Lake Tappan and 4 miles upstream of Oradell Reservoir) between 1942 and 1966 was 91 cfs. Average discharge from 1967 to present was 85 cfs (USGS 2011).

1976: The total capacity of Oradell Reservoir was reported as 3.3 billion gallons (Carswell 1976).

1976: The Hackensack River tidal flow just upstream of the New Jersey Turnpike crossing was estimated at approximately 21,350 cfs (Mattson 1976). The average Hackensack River discharge at New Milford (i.e., the freshwater input) in 1976 was 93 cfs (0.4 percent of the tidal flow).

1990: The operation of three reservoirs on the Hackensack River significantly decreased the freshwater inputs to the lower river system. At times, no flow was measured over the spillway at Oradell Dam, sometimes for several months at a time (BCUA 1990; Vol III, App. A, p13).

2000–2010: Average annual Hackensack River discharge at New Milford (66.1 cfs; USGS 2010) was 0.3 percent of the Hackensack tidal prism (assuming the present tidal flow is equivalent to the 1976 measurements by Mattson), as compared to 0.9 percent of the tidal flow in 1917 before extensive water diversions and withdrawals.

SECTION 6

CHANGES IN PLANT COMMUNITY

The emergent and riparian plant community in tidal marsh systems has a major influence on the organic matter budget/dynamics, oxygen availability, nutrient dynamics, contaminant fate and transport, and the animal community. In the BCSA, the dominant plant community has changed several times since the last glaciation as a result of climate transitions, increasing tidal inundation, and salinity. The chronology of these changes is summarized herein.

13,000–8,000 ya: Dating of basal peats from Norwood (near Oradell Reservoir) indicates that colonization of the former bed of glacial Lake Hackensack was initiated approximately 12,900 ya (Averill et al. 1980). The vegetation community was a mixture of black ash swamp and grassland (Heusser 1949; Sipple 1972).

5,000–2,000 ya: Ash swamp and grassland community was superseded by spruce-larch bog (Averill et al. 1980; Heusser 1949; Sipple 1972). Pollen records from along the Hackensack River at Route 3 confirmed the presence of ash (Fraxinus) pollen and other tree species overlying the lacustrine clay (approximately 2,600 ya) (Carmichael 1980). Spruce-larch pollen was identified at Secaucus, and those forested bog conditions persisted in localized area through the end of the 19th century (Heusser 1949).

2,600–2,000 ya: Pollen and seed records from a core just north of Route 3 along the Hackensack River indicated abundant birch (Carmichael 1980).

2,000–300 ya (approx.): Sedge was the most abundant species in the seed record (*Scirpus* sp. and *Cyperus* sp., with some *Cladium* sp. circa 800 ya). Pollen records from this period included oak and sedge (Carmichael 1980).

1400s–1500s: First record of Atlantic white cedar in the Meadowlands is during this period, based on pollen records from Secaucus. Rising sea level resulted in encroachment of emergent marsh around the bog edges. Marsh peat analysis in Secaucus identified marsh peat consisting primarily of *Scirpus olneyi, Juncus gerardi,* and *Typha angustifolia* (cattail) overlying historical spruce-larch forest peat (Heusser 1949; Sipple 1972).

1600s–1800s: Extensive cutting of cedar took place throughout Meadowlands for ships, road planks, and building material, and burning of swamps occurred to address piracy along the Hackensack River (Wright 1988; HMDC 1973; Kuser and Zimmerman 1995).

1700 (approx.): Onset of silty reed muck accumulation occurred, based on carbon-14 dating and pollen records. Grass and sedge pollen became the most abundant in the pollen record (Carmichael 1980).

1819: A vegetation survey of the Meadowlands identified extensive cedar swamp coverage, and did not report significant coverage by brackish species (Kiviat and McDonald 2002; Sipple 1972). *Phragmites* seed first started to appear in the peat record around this time (Carmichael 1980).

1833: Cedar swamp was present in southern portion of the BCSA, between Berry's Creek and Kingsland Creek (Wright 1988).

1877: The list of plant species in the Hackensack Meadowlands includes *Phragmites* (Kiviat and McDonald 2002).

1889: A vegetation survey identified a significant freshwater marsh component throughout the Hackensack Meadowlands, including Rutherford and Lyndhurst (Sipple 1972). This was generally consistent with pollen records from along the Hackensack River at Rutherford, where *Typha* (cattail) pollen was relatively abundant in the pollen record around this time (Carmichael 1980).

1896: The Vermeule map (Vermeule 1896) identified a significant cedar swamp within the BCSA, in the general vicinity of Walden Swamp, Eight Day Swamp, and in Moonachie/Teterboro.

1904: The Smith map (in HMDC 1973) indicated cattails were present along Berry's Creek, and "Swampy Woodlands" in the vicinity of Walden Swamp and Eight Day Swamp. The Smith report identified freshwater swamp present between Moonachie, Hackensack, and Hasbrouck Heights, in the vicinity of Berry's Creek. No salt marsh species of mosquitoes were identified to be breeding in this area. Cattails were identified as the dominant vegetation from Snake Hill to Little Ferry. "Salt marsh" begins south of Snake Hill.

1914: Cattails and cedar swamp were identified between Paterson Plank Road, the Hackensack River, and BCC (BCMC 1914, as cited by HMDC 1973).

1919: Wild rice (*Zizania aquatica*), which has a maximum salinity tolerance of 3 parts per thousand, was reported to be abundant north of Snake Hill (Harshberger and Burns 1919). A vegetation survey identified freshwater species in Moonachie (Sipple 1972). *Spartina alterniflora*, a brackish to salt tolerant species, was reported from Saw Mill Creek southward (Sipple 1972).

By 1932: *Phragmites* dominated Meadowlands vegetation (Wright 1988), approximately 10 to 15 years after completion of Oradell Dam and dredging of the Hackensack River to Little Ferry (see above).

1930–2008 (approx.): Review of historical aerial photographs confirms the widespread distribution of *Phragmites* throughout the tidal portion of the BCSA (ELM 2008). Analysis of marsh tributary geomorphology confirms the stability of the marshes throughout the 20th century, despite changes in hydrology[5] and wetland losses due to development.[6] These aerial photograph analyses are presented in ELM (2008) and BCSA Group (2012).

1949: The only remaining cedar stand (six cedar trees) in the Meadowlands existed in Moonachie; the other remaining stand, in Secaucus (near Mill Creek), died off in 1935 (Sipple 1972; Heusser 1949).

1969: *Phragmites* was identified as the most common plant in the Meadowlands. Survey within the BCSA identified predominately *Phragmites*; *Spartina alterniflora* was rarely identified along BCC near the confluence with the Hackensack River, as well as *Juncus* sp., *Amaranthus cannabinus*, and *Pluchea purpurascens*. Cattail was noted to occur farther upstream (Sipple 1972).

1984: Patchy *Spartina alterniflora* was noted to be present along LBC near the confluence at the Hackensack River (HMDC 1984). The HMDC report suggested that *Spartina alterniflora* abundance in the Meadowlands was higher at this time than it ever was prior to human modifications of tidal and freshwater flows starting in the 1800s (HMDC 1984).

1998: The Mill Creek Marsh site underwent restoration to remove the *Phragmites* monoculture, excavate the marsh plain to increase tidal flow and improve conditions for *Spartina* growth, create open water impoundments, and grade the surface to support low marsh and upland habitat (USACE 2004). In some areas where low marsh habitat was intended, vegetation did not thrive in some of the lower elevation areas and large areas of open water and extensive mudflats are present at the site during low tide.

1999: Vegetation cover mapping in Oritani Marsh based on 1995 and 1999 aerial photography identified approximately 168 acres of *Phragmites* cover and 2.6 acres of *Spartina* cover (Louis Berger Group 2001). The remaining 20 vegetated acres were characterized as disturbed upland. *Spartina* was localized in the southwestern portion of the marsh, and was confined to small areas along a constructed drainage ditch and in a few scattered patches in close proximity to the ditch. The origin of the *Spartina* is not known but is not evident on aerial photography prior to 1994.

2003: Vegetation surveys were completed in eight marshes as part of a Meadowlands wetland functions and values assessment. The marshes were selected to represent the range of habitat conditions in the Meadowlands, and the vegetation community in each marsh was rated on a scale of 0 to 1 based on extent of "native" plant cover (*Phragmites* was considered nonnative). The scores ranged from 0.1 in *Phragmites*-dominated marshes (Anderson Creek Marsh and Meadowlark Marsh) to 0.8 in a *Spartina*-dominated marsh (Saw Mill Creek) (Louis Berger Group 2004). However, based on the summary of vegetation transitions since the last glaciation, changes in tidal influence and salinity have led to several changes in the dominant vegetation type. In

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[5] Section 5 of the RI Report
[6] Section 7 of the RI Report.

addition, *Spartina* has been recently been introduced more widely in the Meadowlands, as a component of enhancement or mitigation projects.

2004: Low marsh was constructed along LBC as mitigation for the proposed ENCAP development (Paulus, Sokolowski, and Sartor, LLC 2001). The restoration replaced the *Phragmites* vegetation with *Spartina* and other species, and lowered elevations to increase tidal inundation. However, the sediments subsided following removal of the *Phragmites* and associated root mat, and the *Spartina* that was planted was not able to establish over wide areas of the restoration. In many areas, planting areas targeted for final elevations between 4 and 10+ ft North American Vertical Datum of 1988 (NAVD 88) are presently at elevations between approximately 1.5 and 6 ft NAVD 88 based on the digital elevation model developed for the BCSA RI.[7] Plants within the restoration area are only present above elevations of about 2.5 ft NAVD 88. Presently (in 2017) the mitigation area is predominately mudflat at low tide, with localized pockets of vegetation in areas that had higher post-construction elevations (based on field observations).

2007: Wetland restoration was performed at the Secaucus High School site with the goal of eradicating the *Phragmites* monoculture, increasing the tidal connection for twice-daily inundation, and planting native brackish vegetation. As a result of the restoration, self-sustaining low marsh, high marsh, and lowland scrub-shrub habitats exist at the site.[8] In contrast to many restoration sites in the Meadowlands that involve removal of both the aboveground *Phragmites* vegetation and the root mat, at the Secaucus site, the *Phragmites* was killed through repeated herbicide application, but the dense root mat was left intact in many areas. The root mat provided added stability while the newly planted vegetation was being established, and contributes to the success of this restoration area.

2010: Vegetation survey conducted in the BCSA as part of a wetland functions and values assessment identified *Phragmites* as the dominant species throughout the study area and in the Bellman's Creek reference area. The Mill Creek reference area exhibited greater diversity in the plant community due to the restoration activities noted above (BioHabitats 2010).

2010: Restoration of the Richard P. Kane Natural Area began in 2010 to provide a wetland mitigation bank for tidal wetlands lost during approved transportation projects with the Hackensack Meadowlands. Prior to 2010, the site was dominated by *Phragmites*, and was segregated from tidal influence by dikes along the eastern portion of the site. The existing *Phragmites* stands were treated with herbicide, and native *Spartina* marsh grasses were planted. Issues with achieving proper elevations resulted in more open water than intended and

[7] Refer to Attachment G1 of Appendix G.
[8] http://meri.njmeadowlands.gov/mesic/sites/existing-restoration-preservation-mitigation-sites/secaucus-high-school-2/.

substantially less low marsh habitat than specified in the approved design (USACE 2004; TAMS Consulting, Inc. 1998; NJMC 2009; Morgensen 2010).

2015: As part of a semi-quantitative survey, 23 habitat types were mapped and the vascular flora and plant assemblages of the BCSA were documented.[9] For this study, 68 sites were sampled, representing different habitats of the BCSA. Representative sites were selected throughout the BCSA based on consideration of gradients in elevation, salinity, habitat edges, and height of vegetation cover. Sites that were surveyed included marshes, wet meadows, upland edge (ecotone) habitats, dredged material deposits along BCC, and other types of wetland fill. From semi-quantitative samples, the survey recorded 216 plants identified to species and 41 additional plants identified only to genus or family; qualitative observations revealed another 52 species. Because the survey was limited to a portion of the later part of the growing season and finite number of locations, some species were probably not discovered, including some grasses, sedges, and spring ephemeral wildflowers. Of the 268 species identified, 56 percent, were native to New Jersey; the rest were either nonnative species originating from other U.S. regions or countries, or species of indeterminable origin. The predominance of native species in the species list indicates the diversity of habitats and available flora in the BCSA with much of the diversity of native species associated with edge and recently disturbed areas. Although native species predominated in the flora based on number or species identified, several nonnative species also were abundant. The European form of common reed (*Phragmites australis*) was the most dominant plant species surveyed throughout the BCSA, consistent with other marsh areas throughout the Meadowlands.

[9] Refer to Attachment I7 of Appendix I.

SECTION 7

LAND DEVELOPMENT PROGRESSION

The BCSA is a highly urbanized watershed in one of the most urbanized regions in the world. This condition influences the water budget, sediment budget, and background contaminant loading to the estuary. In addition, widespread filling of tidal wetlands has also impacted the tidal system.

7.1 Land Development Progression

The chronology and progression of land development is as described below.

1600s–1800s: Throughout the Meadowlands, cedar swamps were cut to build ships and roads; the cattails and large reed grasses were harvested for thatch and other uses; pits were dug to mine clay; and, the meadow cord grass was mowed for hay (NJMC 2004; Marshall 2004).

Late 1700s: The BCSA was undeveloped based on review of historical maps (Grubb 2010 [Appendix F of BCSA Group 2010]).

1833: Paterson and Hudson River Railroad was constructed, and a portion traversed the BCSA (Grubb 2010 [Appendix F of BCSA Group 2010]).

Early 1800s: Construction of Paterson Plank Road, Moonachie Avenue, Washington Avenue, and possibly a precursor to Route 17 occurred in the BCSA (Grubb 2010 [Appendix F of BCSA Group 2010]).

Mid-1800s to 1913: Limited development began within the BCSA, but was constrained to upland areas along existing roads (Grubb 2010 [Appendix F of BCSA Group 2010]).

1900-1950 (approx.): Development was largely in upland areas and high marsh areas around the tidelands perimeter. Residential development was concentrated in the uplands west and north of the tidal area, while commercial/industrial development tended to occur closer to the tidal area. Debris dumping and landfilling took place throughout the BCSA, but was particularly concentrated in LBC (ELM 2008).

1911: BCC was constructed (Erie Railroad Company 1910; Wright 1988) to facilitate rail transportation.

1916–1918: Ongoing work was completed by the Riser Land Company to drain swamps around the East Riser Ditch for development in Lodi, Little Ferry, and Moonachie. Ditch maintenance and channelization was also ongoing in the West Riser during this time period (HMDC 1973).

Pre-1930: Filling took place in the freshwater wetlands for the construction of the Teterboro Airport in the northern portion of the BCSA; based on review of historical aerial photographs, additional runways were added sometime between 1930 and 1951 (ELM 2008).

1930–1947: Based on review of historical aerial photographs, the West Riser Ditch was channelized/straightened between the tide gate and Moonachie Avenue during this time period (ELM 2008). This work was undertaken by the Riser Land Company (HMDC 1973).

1950-1970 (approx.): In the tidal portion of the BCSA, extensive filling of first high marsh, then low marsh closer to waterways, took place for commercial/industrial uses based on review of historical aerial photographs (ELM 2008). Debris dumping and landfilling continued in the LBC area.

1961–1968: Based on review of historical aerial photographs, the lower portion of the East Riser Ditch was channelized/straightened between the tide gate and Moonachie Avenue during this time period (ELM 2008). This work was undertaken by the Riser Land Company (HMDC 1973). The original course of Ackerman's Creek in MBC was also filled in and developed, with only the upper section abutting the railway adjacent to Route 17 remaining (ELM 2008). Flow was rerouted to a straight ditch, and development along the straightened ditch followed.

1970s: The BCSA upland reached essentially full build-out (over 90 percent developed). The largest single development during this time period was the construction of the NJSEA sports complex between Walden Swamp and Washington Avenue in 1972 (ELM 2008).

2007–2009: Construction of a New Jersey Transit Railroad Bridge south of Paterson Plank Road, at the north end of Walden and Ackerman's marshes, included placement of piers and filling for the rail bed in the waterway and wetlands. Redevelopment/construction activities at the NJSEA facility included construction of a new stadium and the Xanadu complex, with additional impervious surfaces and associated runoff. Construction of the rail bridge, the new stadium, and the Xanadu development were observed first-hand by field teams and are evident in aerial photography from 2007 through 2009 (historicaerials.com).

2014: Based on first-hand observations by field teams, construction of a new residential development occurred in a former industrial zone on Chubb Avenue near the western bank of LBC, in an area of previously filled wetland.

2015: Based on field observations, construction of a new residential development took place on the Route 3 Service Road near New Jersey Turnpike Exit 16W adjacent to the northeastern edge of Tollgate Marsh, in an area of previously filled wetland.

Acreage of wetland/open water losses and filling were quantified based on review of historical aerial photographs (ELM 2008):

Table 5. Comparison of Acreage Filled/Developed between Years of Analysis in the BCSA

1896 to 1930	1930 to 1951	1951 to 1971	1971 to 2002	2002 to 2009
160	226	1,662	717	16

Table 6. Comparison of Wetland/Open Water Acreages between Years of Analysis in the BCSA

BCSA Segment	Year of Analysis					
	1896[a]	1930	1951	1971	2002	2009[b]
Non-Tidal	*1,327*	801	766	650	375	363
UBC	*651*	720	674	247	178	178
MBC	*1,241*	1,284	1,178	598	356	356
LBC/BCC	*1,146*	1,400	1,361	822	691	687
Total Wetland/ Open Water Acreage	**4,365**	**4,205**	**3,979**	**2,317**	**1,600**	**1,584**

Notes:
UBC = Upper Berry's Creek, MBC = Middle Berry's Creek, LBC = Lower Berry's Creek, and BCC = Berry's Creek Canal.
[a] The italicized wetland/open water acreages per segment are approximate due to the scale and accuracy of the source map (Vermeule 1896).
[b] Non-tidal wetlands estimated based on New Jersey Department of Environmental Protection (NJDEP) 2007 land use/land cover mapping from aerial photography.

7.2 Landfill Progression

The chronology of landfill development is as follows:

Early 1900s: Localized dumping noted at various locations throughout the BCSA (BCMC 1914, as cited by HMDC 1973).

1920–1950s: Scattered municipal dumps and non-regulated dumping areas operated at locations throughout BCSA, particularly on the east side of MBC, including the area currently occupied by the NJSEA complex (ELM 2008).

1930: Extensive landfilling is not evident around LBC based on review of historical aerial photograph (ELM 2008).

1947: Filling of wetlands along both banks of LBC is evident in aerial photography (ELM 2008).

1960–1975: This is a peak period of landfilling activity in LBC (Sullivan 1998; Figure 2).

1961: Extensive landfill activity was evident south of LBC (i.e., Lyndhurst Landfill); activity was evident north of LBC (i.e., Rutherford Landfill, Viola Landfill, and north end of Avon Landfill) but was less extensive (ELM 2008).

1968: Rutherford Landfill East had been extensively filled, and activity was evident in Rutherford Landfill West; Lyndhurst Landfill appeared to be close to maximum extent. Little change was evident in the Viola Landfill and Avon Landfill areas as compared to 1961 (ELM 2008).

1974: Rutherford Landfills East and West and Viola Landfill appeared to have reached their maximum extent; Avon Landfill was close to its maximum extent (ELM 2008).

2000–2001: RI activities commenced at Lyndhurst and Rutherford Landfills (Kimball & Associates 2001).

2009-Present: Construction of cap, containment structures, and leachate collection systems are ongoing at both Lyndhurst and Rutherford Landfill West. Closure for Rutherford Landfills East and West was completed in the summer of 2012. Final designs for the Lyndhurst Landfill were completed in fall 2012, and most of the designed elements were either installed or in the process of being installed in June 2013, and were scheduled to be completed by the end of the year (Hickey 2013).

2015: The NJSEA (formerly NJMC) accepted a bid from Russo Development/Forsgate Industrial Partners to purchase the former landfills that were previously slated for redevelopment by EnCap Golf Holdings (NJSEA 2015c). Initial information indicates that the redevelopment will be a mixed-use commercial project (Moss and Brennan 2015).

SECTION 8

SEWAGE MANAGEMENT AND TREATMENT

Circa 1914, between Moonachie Road, Little Ferry Road, Paterson Plank Road, and Berry's Creek, sewage was managed using a series of ditches on both sides of the road and laterals running into farm lands, due to the lack of a municipal sewage system (BCMC 1914, as cited by HMDC 1973).

Major sources of sewage to Berry's Creek included five municipal sewage treatment plants (Hasbrouck Heights, Wood Ridge, Carlstadt, Rutherford, and East Rutherford). Sources of lesser importance were cesspool overflows to tributary ditches in Teterboro and Moonachie.

Significant industrial sewage sources included Georgian Textile Co. (East Rutherford) and Schetty Bros. Dye Works (Carlstadt), which discharged to municipal sewer systems, and Advance Piece Dye Works (East Rutherford), which discharged wastes directly into a tributary of Berry's Creek (NJDOH 1930).

Each of the major sewage treatment systems is discussed below.

8.1 Hasbrouck Heights Sewage Treatment Plant

The Hasbrouck Heights Sewage Treatment Plant (STP) opened in 1926 and was located on the west bank of the West Riser Ditch, upstream of Moonachie Avenue near Teterboro Airport. The plant provided primary treatment (screen chamber, two settling tanks, dosing tank, sprinkling filter, sludge beds; final settling tank and chlorinator were never constructed). The Hasbrouck Heights STP was designed for a flow of 314,000 gal/day and for an 8-hour detention period for settling (NJDOH 1930). Effluent from the STP was discharged to West Riser Ditch, which was generally dry except for effluent. Flood tides did not reach effluent, and in 1930 the discharge was observed to infiltrate within 0.25 mile of the discharge point (NJDOH 1930) except during stormwater runoff periods. The low gradient of West Riser Ditch where plant discharged resulted in flow splitting and traveling both upstream and downstream from discharge point.

1930: System performance was reported in NJDOH (1930):

- Average flow of 240,000 gal/day.
- High percentage of suspended solids removed.

- 100 percent of settleable solids removed.[10]
- Reduction in nitrogen concentrations.
- Report noted that the observed performance was measured under low-flow conditions, and similar results would not have been achieved under normal conditions.

1969: Flows were diverted to Bergen County Utilities Authority (BCUA) STP in Little Ferry, which discharges to the Hackensack River (BSAWA 1983).

8.2 Wood Ridge Sewage Treatment Plant

The Wood Ridge STP began operations in 1925 and was located on the west bank of the West Riser Ditch, upstream of the tide gate near the current rail crossing. The plant provided primary treatment (screen and grit chamber, settling tank, sludge digestive compartment, two sludge beds) (NJDOH 1930). The Wood Ridge STP design capacity was 387,000 gal/day with a 2.5-hour detention period. Effluent discharged to the West Riser Ditch just upstream of the West Riser tide gate. The NJDOH (1930) report noted very little freshwater flow through the ditch to dilute effluent, with the majority of the flow derived from upstream Hasbrouck Heights STP and water pumped from behind a dike in Teterboro. The report also noted that anoxic conditions were observed upstream of West Riser tide gate essentially 100 percent of the time.

1930: System performance was reported in NJDOH (1930):

- Measured 1930 daily flow of 240,000 gal/day.
- 63 percent removal of suspended solids.
- 97 percent removal of settleable solids.

1954 to 1962: STP was upgraded to include secondary treatment, which functioned only intermittently (Borough of Wood-Ridge, no date).

1976: Average flow rate was approximately 1 mgd (Mattson and Vallario 1976).

1981–1982: Average discharge rate was 0.41 mgd (BSAWA 1983); the STP failed to meet New Jersey Pollutant Discharge Elimination System (NJPDES) permit conditions for percent suspended solids removal in discharge.

1983: Average discharge rate was 0.57 mgd and TSS loadings were 83 kg/day (Anonymous 1984).

[10] Settleable solids is a standard measurement in wastewater treatment and refers to those solids that will settle to the bottom of an Imhoff cone in a given time period.

1990: Plant discharged an average of 0.6 mgd of sewage that received primary treatment (BCUA 1990).

1991: Flows were diverted to BCUA STP in Little Ferry, which discharges to the Hackensack River (NJDEP 1991). This diversion ended direct discharge of publicly owned treatment works sewage effluent to the BCSA.

8.3 Carlstadt Sewage Treatment Plant

The Carlstadt STP began operations in 1910 and was located in the vicinity of Broad Street at 16th Street. The plant provided primary treatment only (settling tank). The Carlstadt STP had a design capacity of 77,400 gal/day with an 8-hour detention period for settling (NJDOH 1930). Sludge beds were never provided, so sludge was pumped directly into the adjacent marsh. Effluent was initially discharged into a ditch along Paterson Plank Road, but was rerouted to discharge further upstream in Berry's Creek, near the West Riser tide gate (possibly Nevertouch Creek) (NJDOH 1930).

1911–1915: Multiple sources reported that the Carlstadt STP separated solids at one end; the effluent then flowed out of the plant into an unnamed ditch and hence to Berry's Creek. It was noted that the marsh surrounding the ditch exhibited evidence of sewage overflow (HMDC 1973).

1930: System performance was reported in NJDOH (1930):

- Average daily flow was 175,000 gal/day (2 times design capacity) during a dry period, but the pump station frequently operated at rates up to about 540,000 gal/day (7 times design capacity).
- 67 percent suspended solids removal.
- Visible "black pollution" and gas generation in creek.
- No oxygen measured in creek.

1941: Sewage was diverted to Tri-Boro STP and Carlstadt STP closed (CBA 1966).

8.4 Rutherford Sewage Treatment Plant

The Rutherford STP began operations in 1925 and was located in the vicinity of Highland Cross Road at Route 17. The plant provided primary treatment only (settling tank and sludge bed). The maximum design capacity for the Rutherford STP was 1,345,000 gal/day with an 8-hour detention period for settling (NJDOH 1930). The sludge was dried and filled into the swamp. Settling tank effluent was discharged into a ditch that ran alongside the tracks of Erie Railroad for a distance of 0.75 mile before discharging to LBC immediately downstream of the confluence with BCC.

1930: System performance was reported in NJDOH (1930):

- Measured flows of 190,000 to 1,000,000+ gal/day.
- 30 percent removal of suspended solids.
- 57 percent removal of settleable solids.

1941: Sewage was diverted to Tri-Boro STP, and Rutherford STP closed (CBA 1966).

8.5 East Rutherford Sewage Treatment Plant

The East Rutherford STP opened circa 1908 and was located in the vicinity of Hackensack Street at Orchard Street. The plant provided primary treatment only (settling tank and bar screen). The East Rutherford STP had a design capacity of 280,000 gal/day with an 8-hour detention period for settling (NJDOH 1930). Sludge was pumped into the adjacent marsh. Effluent was discharged into a tidal ditch (possibly Ackerman's Creek area), which joined another ditch that received dye wastes from Advanced Piece Dye Works.

1930: System performance was reported in NJDOH (1930):

- Average daily flow of 415,000 gal/day (1.5 times design capacity).
- 36 percent of suspended solids removed.
- 8 percent of settleable solids removed.
- Visible raw sewage, "black pollution," and gas generation in the ditch.

1941: Sewage was diverted to Tri-Boro STP, and East Rutherford STP closed (CBA 1966).

8.6 Tri-Boro Sewage Treatment Plant (Rutherford)

The Tri-Boro STP began operations in 1941 in the vicinity of Murray Hill Parkway at Branca Road, and replaced the Carlstadt, East Rutherford, and Rutherford STPs. The plant provided primary treatment only (settling tank). The Tri-Boro STP had a design capacity of 2.9 mgd (NJDEP 1986). Effluent from the STP was discharged to MBC via a ditch.

1976: Average flow was 4 mgd (1.4 times design capacity).

1981–1982: Average discharge rate was 2.64 mgd; STP failed to meet NJPDES permit conditions for biological oxygen demand removal and suspended solids in discharge.

1986: Plant discharged approximately 4.3 mgd of sewage that received primary treatment only; approximately 50 percent total volume was industrial flow (NJDEP 1986).

- 13,900 wet tons sludge/yr disposed at landfill.
- Percent removal efficiency of priority pollutants—volatile organic compounds: 31 percent; base neutral semivolatile organic compounds: 34 percent; pesticides and polychlorinated biphenyls: 50 percent; metals: net increase.

1988: Plant discharged an average of 3.1 mgd of sewage until flows were diverted to BCUA STP in Little Ferry, which discharges to the Hackensack River (BCUA 1990).

8.7 Hackensack River Watershed

Key facts regarding the Hackensack River Watershed include the following:

1970: A total of 121 mgd of sewage, subject to varying degrees of primary or secondary treatment, was discharged within the Meadowlands district and resulted in significant dissolved oxygen depression and nutrient loading in the Hackensack River (Mattson and Vallario 1976):

1976: Seven STPs were reported to be discharging 115 mgd within the Meadowlands district, a reduction from 1970 due to implementation of pollution abatement measures (Mattson and Vallario 1976).

1987–1988: Thirty-three percent of all dissolved oxygen measurements throughout the Meadowlands were below the regulatory criteria of 4 mg/L, largely due to sewage inputs (HMDC 1989).

1990: An STP in Little Ferry discharged approximately 65 mgd to the Hackensack River (BCUA 1990). The estimated cost to upgrade this treatment system to achieve consistent dissolved oxygen concentrations 4 mg/L or greater in the Hackensack River was $70M.

2002–2003: Water quality measurements throughout the Meadowlands suggested a slight improvement in dissolved oxygen concentrations since the 1987-1988 HMDC study (HMDC 1989), with a 10 percent decrease in the number of dissolved oxygen readings below the regulatory criteria of 4 mg/L (NJMC 2005).

2011: NY/NJ Baykeeper and Hackensack Riverkeeper petitioned NJDEP to revoke its Statewide General Permit for Combined Sewer Systems. The lawsuit was allowed to proceed following an Appellate Court decision in 2013 (Docket No. A-6127-10T2).

2012: Based on a review of NJDEP's list of NJPDES-permitted facilities (dated February 2012), there were 29 combined sewer overflows discharging to the lower Hackensack River. As a result, there is continuing evidence of sewage-discharge impacts entering the BCSA from the Hackensack River discharges.

2015: NJDEP issued updated combined sewer overflow discharge permits that will phase in more stringent effluent requirements, particularly aimed at improving water quality in urban areas (NJDEP 2015).

SECTION 9

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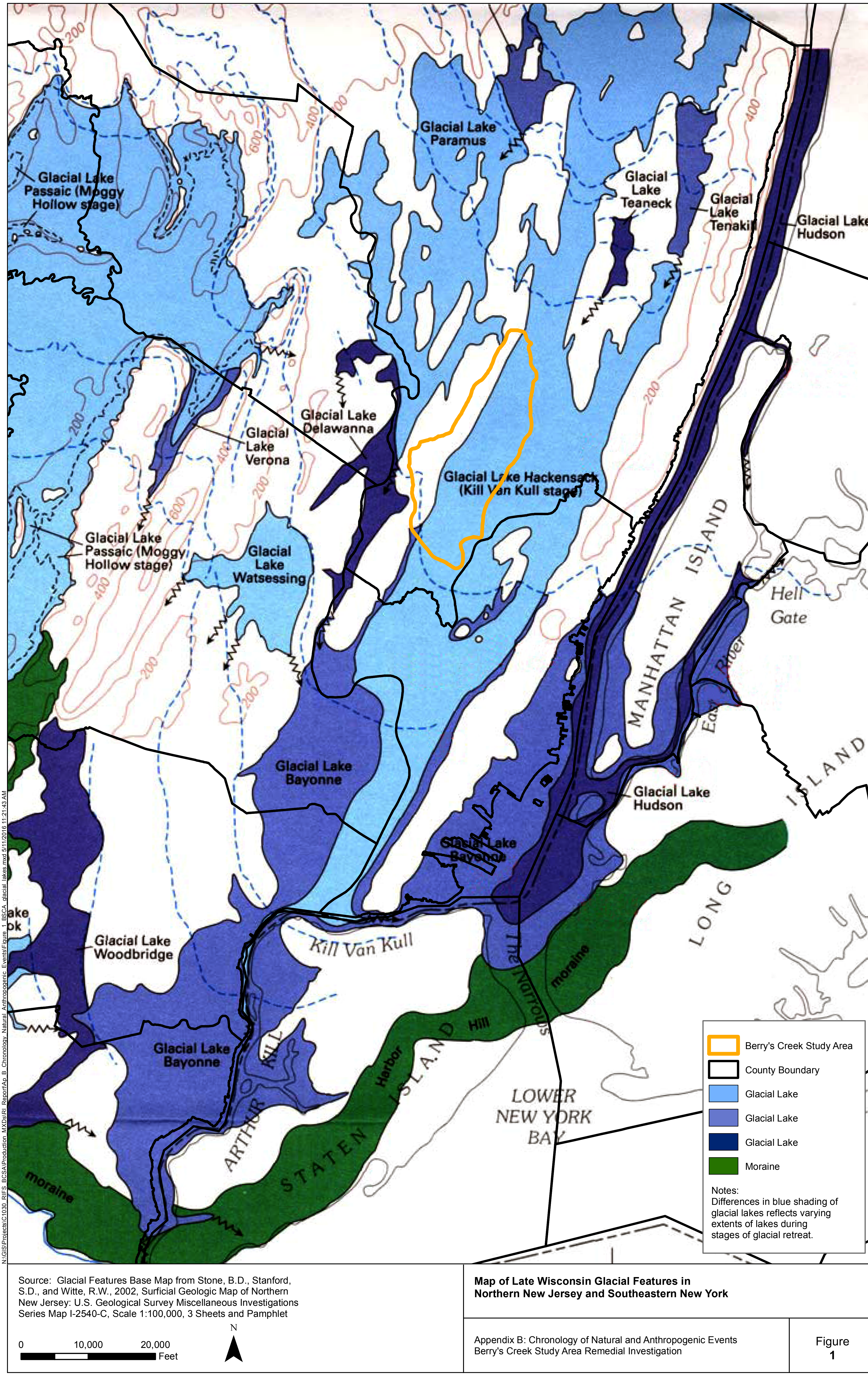
FIGURES



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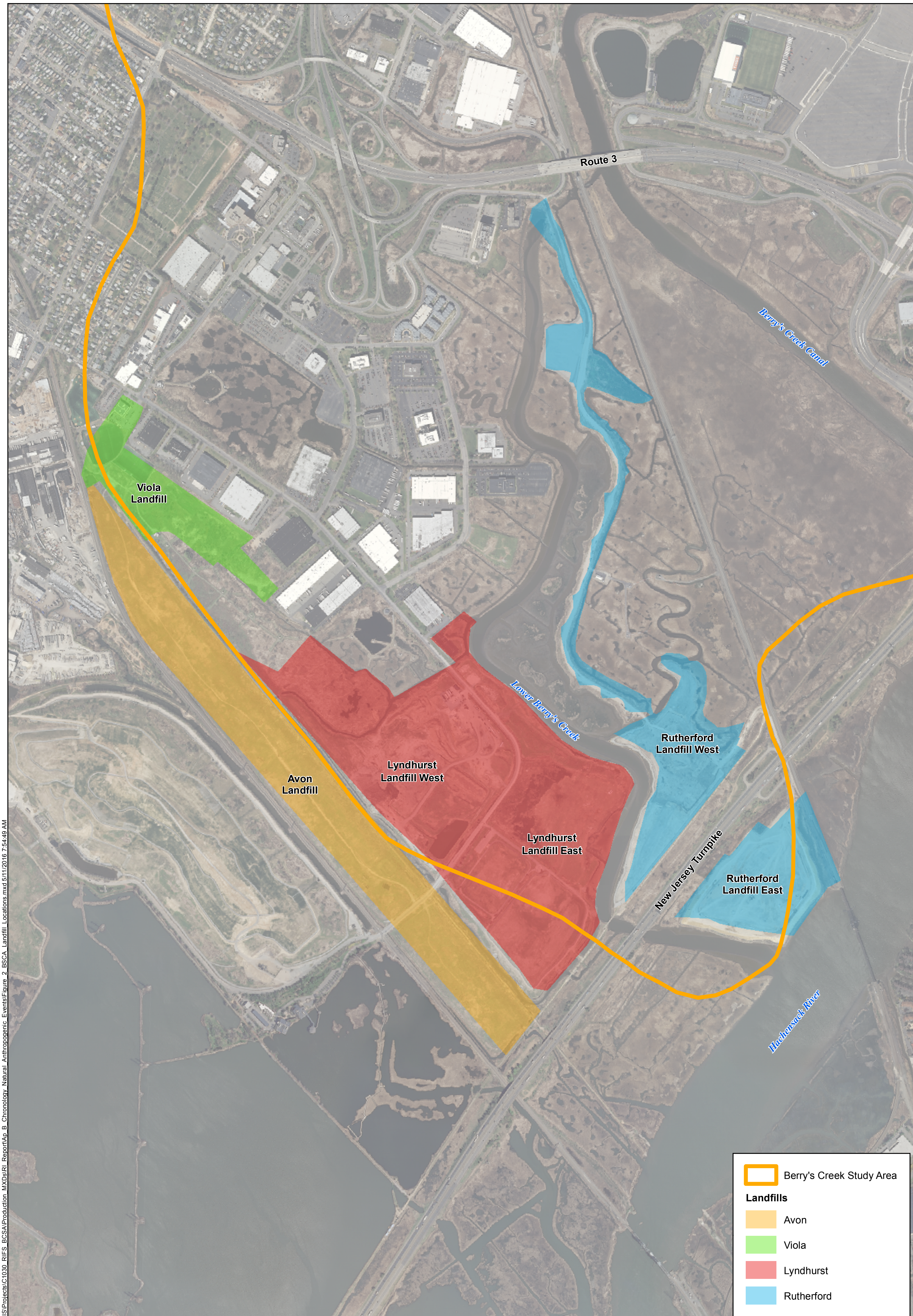
Source: Glacial Features Base Map from Stone, B.D., Stanford, S.D., and Witte, R.W., 2002, Surficial Geologic Map of Northern New Jersey: U.S. Geological Survey Miscellaneous Investigations Series Map I-2540-C, Scale 1:100,000, 3 Sheets and Pamphlet

Map of Late Wisconsin Glacial Features in Northern New Jersey and Southeastern New York

Appendix B: Chronology of Natural and Anthropogenic Events
Berry's Creek Study Area Remedial Investigation

Figure 1



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Notes:
This map was created using New Jersey Meadowlands Commission/Meadowlands Environmental Research Institute Geographic Information Systems Digital Data (2009), but this is a secondary product and has not been verified and is not authorized by the NJMC/MERI GIS.
Basemap Source: NJ Imagery, Natural, 2013.

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Landfill Locations in Lower Berry's Creek

Appendix B: Chronology of Natural and Anthropogenic Events
Berry's Creek Study Area Remedial Investigation

Figure
2